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IN THIS ISSUE . . .

Current Trends

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Covered by articles in this issue . . .

Agriculture and environmental degradation in **Australia**

South Korea's official assistance to agricultural producers

Recent environmental legislation affecting livestock production in **Western Europe**

"Pollution intensity" of major **U.S.** crops

Chile's thriving fruit industry

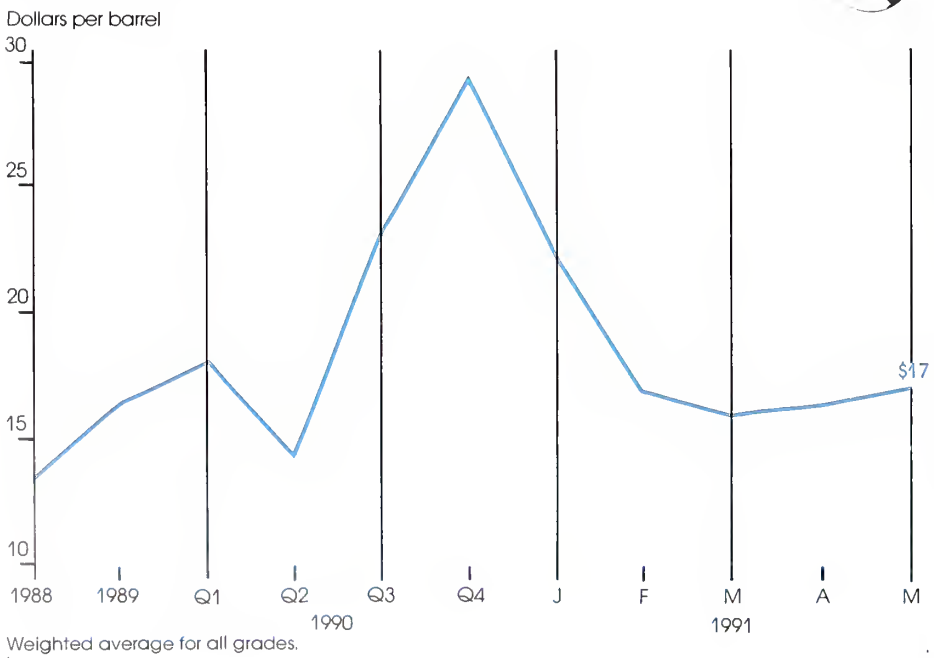
The World Economy and Exchange Rates

The inertia of 1990's global economic slowdown will keep 1991's real GDP growth at 1.0 percent—the weighted average of 1.3 percent for the developed economies, 2.6 percent for the developing countries (LDC's), and 4.4 percent for Central Europe and the USSR. World economic growth in 1990-91 is the trough in the business cycle that last peaked in 1988 and which is projected to slope upward starting in 1992. A recovery to 3.3 percent in real GDP growth in 1992 will reflect rebounds in the developed economies of 1.8 percent, 2.7 percent in the LDC's, and 3.9 percent in Central Europe and the USSR.

Inflation is projected to subside substantially in 1991, and by more in 1992. Weaker overall demand, and crude oil prices at or under $20 per barrel, will slow increases in consumer prices, which should eventually lead to real output gains in 1992 for most countries. Significant recoveries in economic activity are expected in North America, Latin America, and the Middle East in 1992. Central Europe and the USSR will remain in recession. Stronger growth in Asia will be driven by a 14-percent nominal gain in export earnings in 1992, a portion of which derives from Japan's increased import demand.

Agricultural commodity prices have trended downward since 1989. Both agricultural raw materials and food have lost 11.2 and 8.8 percent, respectively, of their values from 1989. Current prices for food are only 8 percent higher than in 1985, whereas raw material prices are still 30 percent higher. Sagging world demand, large crop harvests, and tighter worldwide money have pushed inflation down and dragged agricultural commodity prices down as well. Agricultural export subsidies could potentially increase if GATT negotiations do not succeed, bringing further deterioration in agricultural trade and prices.

FIGURE 1 **World Crude Oil Price**



Weighted average for all grades.

The Developed Economies

Japan and the European Community (EC) are experiencing a cyclical slowdown. In Japan, higher interest rates and rocky equity markets have substantially reduced domestic investment growth, projected to be less than half 1990's 10.6-percent real gain. Also, the yen's appreciation against the dollar in 1990 and the current U.S. recession will contribute to Japan's expected lower export growth in 1991. Similarly, in Europe, much higher German interest rates and exchange rate appreciation against the dollar (in 1990) caused the cyclical adjustment, part of which is the EC's new trade deficit with the United States. A reversal of these trends is expected in 1992 as France, Italy, and the United Kingdom post higher real GDP growth.

The United States, Canada, and the U.K. are expected to post impressive real GDP gains of 3.3, 3.9, and 2.5 percent in 1992, respectively, from their current mild recessions. Germany will continue to expand at a healthy 3.1 percent in 1992 despite slowing domestic demand. Japan should once again be growing at a strong 3.8-percent pace in 1992 as private consumption and exports stage a comeback, along with public expenditures growth.

The Developing Countries

Real output growth in the LDC's will double in 1992 if the projected expansions in Latin America (from 1.5 percent in 1991 to 3.6 percent in 1992), and in the Middle East (from -7.9 to 8.8 percent) materialize. A fourfold reduction in inflation in 1991 and a further halving in 1992 are counted on to pull Latin America out of its recession in 1991. In the Middle East, the presumed return to normal activity in Kuwait and the lifting of economic sanctions against Iraq should fuel much of the region's recovery in 1992, despite the projected languid performance in Saudi Arabia and other neighboring countries. Lower real revenues from

FIGURE 2 **Commodity Prices**

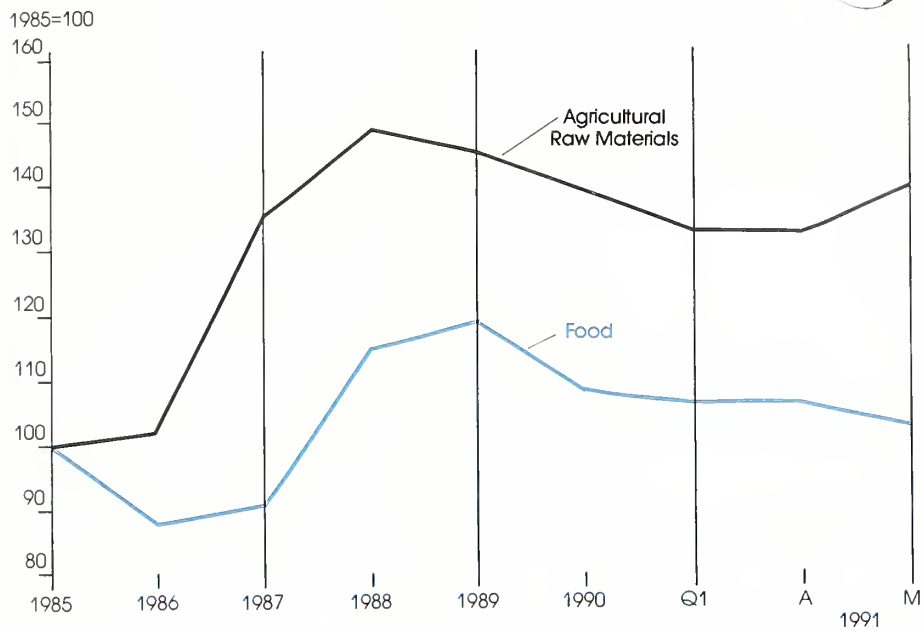
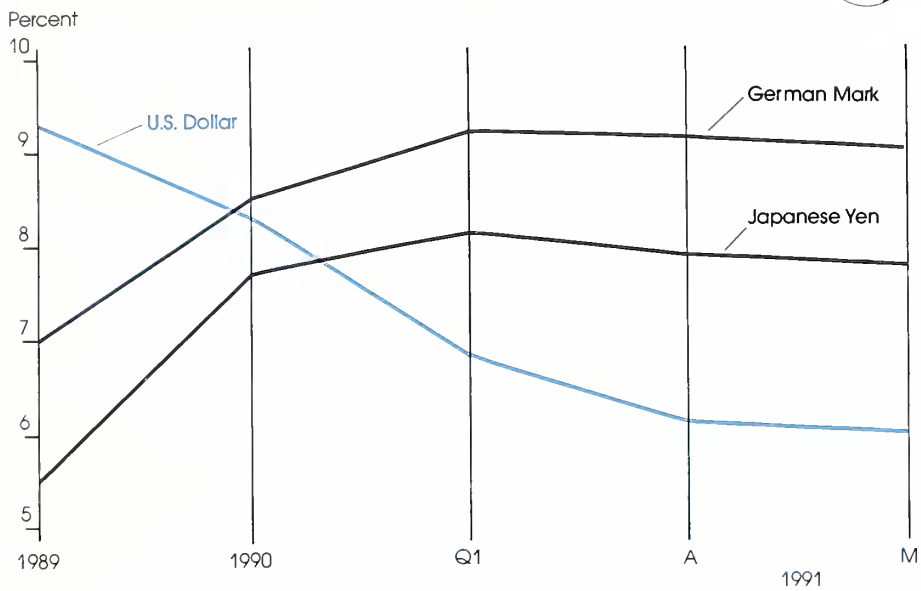


FIGURE 3 **Eurocurrency Interest Rates**



For 3-month deposits.

exports of oil and petroleum products in 1992 is the principal reason for the latter's retreat.

Led by the newly industrialized countries of East Asia, Asia's real GDP growth is expected to exceed 6 percent in 1992, the highest since 1988's performance. Export growth of almost 14 percent is driven by continued strong inter-regional demand and especially by Japan's doubled import growth in 1992 from 1991. In Africa, lower economic activity in Algeria, Egypt, Nigeria, and only marginal gains in South Africa, should keep the continent growing sluggishly in 1992, by far the slowest among the LDC's.

Central Europe and the USSR

Only Poland is expected to register a positive output gain in 1991 in Central Europe. The slow transition to market economies has been hampered by the low rate of foreign investment, except in Hungary, where about half of the region's large investments have been made so far. In Poland and Czechoslovakia, foreign investments are generally in small importing and exporting businesses. When commercial laws are introduced, the bureaucracy is streamlined, infrastructure is improved, and restrictions on repatriation of hard currency profits are minimized, cash inflows are more likely to accelerate.

The unrestricted movement of payments—the freedom to acquire and transfer not only foreign goods and services but also foreign currencies—entails currency convertibility. Convertibility will subject domestic producers to competition from abroad and at the same time import a system of economic pricing. The demand for foreign exchange has risen with the deterioration of terms of trade and export earnings as a combined result of the Persian Gulf crisis and trade conducted in hard currency with the USSR. Without the preconditions of macroeconomic stabilization, demonopolization, well-defined and enforced property rights, and freely flexible domestic prices, currency convertibility will exacerbate unemployment, raise inflation, and pressure wages and interest rates upward.

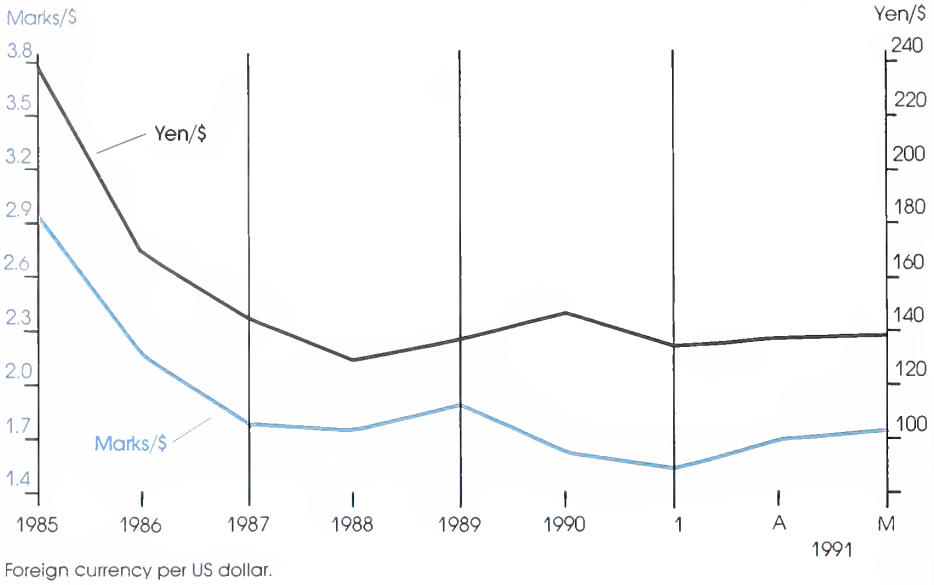
World Trade

The EC has proven to be an attractive market for U.S. goods as it pulls in imports because of dollar depreciation in 1990, and also as U.S. goods displace formerly high German exports, much of which have gone to eastern Germany and Central

Europe. The recent rise in the value of the dollar, however, will raise oil import costs of many LDC's. The weak developed economies will seriously reduce their import demand from Africa and Latin America in 1991, and these regions' heavy external debt will in turn adversely affect their own import demand. Overall, world real exports will grow faster (above 5 percent) starting in 1992 even as export price increases fall along with general consumer price inflation.

A Free Trade Agreement between the United States and Mexico, if successfully negotiated, may initially limit trade expansion as long as both countries remain heavily indebted and under pressure to increase exports to the rest of the world. In Central Europe, room for trade expansion is enhanced by the low volume of intra-regional trade, since previous trade ties were predominantly with the USSR. Export growth for the region is projected to turn positive in 1992 as more of the economies overcome recession and as economic activity in the West picks up.

FIGURE 4 **Exchange Rate of the Dollar**



Foreign currency per US dollar.

World Petroleum

World oil prices are only marginally higher than spring 1990's average of $15 a barrel, just before the Persian Gulf crisis that doubled prices to $30 by the fourth quarter. Despite efforts by the Organization of Petroleum Exporting Countries (OPEC) to cut its output by 5 percent, or by 1 million barrels a day (mbd), to 22.3 mbd, prices have remained stable. The reasons for this are: low demand from the industrialized countries, mainly the United States, due to slowed economic activity; seasonally slack use of oil for heating, or gasoline for longer-range driving in the spring; and the still-abundant stocks that were built up before and during the winter, which turned out to be a mild one.

The outlook for stable prices appears favorable in the near to medium term. The return of some Kuwait production by next year and the greater production capacities recently installed or upcoming should more than offset declining outputs in the United States and USSR. The largest oil importer—the United States—has cut imports by more than 1.5 mbd since early last year. U.S. domestic production currently exceeds net imports by more than 1 mbd, in contrast to only a year ago when net imports topped domestic production by almost 1 mbd.

Interest Rates

Fear of inflation and excess demand for funds in Germany have resulted in higher real interest rates in that country and in all the members of the European Monetary System. Only by official currency devaluation can they find room to cut interest rates and revive flagging demand. In Japan, slower money supply growth to ease inflationary pressures pushed short-term interest rates from half of U.S. rates in early 1989 to current levels of almost 2 percentage points higher than U.S. rates. Real interest rate differentials of more than 2 percentage points favor the Japanese yen, and the German mark by 4 points, over the U.S. dollar.

These real differentials were behind the yen's appreciation in the last three quarters of 1990 and the D-mark's appreciation since 1989. The recent depreciation of these currencies against the dollar may have to do more with discounting prospectively weaker German and Japanese economies, and the perception of the imminent revival of the U.S. economy. The ebullient equity markets in the United States, partly in response to lower short-term interest rates, have also helped strengthen the dollar.

The demand for capital in the Middle East—for war-related reconstruction and for renewed weapons purchases—will divert some funds demanded in Central Europe and the USSR as well as in hard-pressed LDC's. Also, the global supply of funds eventually will be tapped by U.S. companies in a reviving U.S. economy. These demands will most likely put upward pressure on interest rates once again, because former capital exports by Germany and

Japan have dried up due to the shrinking of their current account surpluses. It is predicted that real interest rates will average more than 4 percent in 10 industrialized countries between 1991 and 1995, in part because of overall lower savings.

Exchange Rates

The dollar's recent appreciation will be difficult to sustain until the perceived revival of the U.S. economy actually comes about. In apparent reaction to expectations, the foreign exchange market has shifted much favor from the D-mark to the dollar and less so against the yen. Apprehension surrounding the political survival of the USSR is also contributing to jitters about holding German marks. An additional demand for dollars has been the continued growth of U.S. exports, given relatively strong foreign economic activity. As long as the dollar's exchange value stays below estimated purchasing power parity rates, the medium-term prospects for U.S. exports should be favorable. The recent strength of the dollar, however, might spur import demand, even if the U.S. economy recovers only slowly.

Like the United States in the early 1980's, Germany is entering this decade with a tight monetary policy and expansionary fiscal policy. In the absence of sufficient internal financing, these should similarly lead to the U.S. experiences of a deepening current account deficit and an overvalued currency. Correspondingly, higher interest rates in the EC would be detrimental to world credit supply, especially to the Community's eastern neighbors. In contrast, Japan's narrowing external surplus reflects the internal adjustment of investment growth to high savings. Consequently, the exchange value of the yen rose against the dollar in 1990 and has not backtracked as much as the D-mark has in recent months.

To sustain foreign capital's attraction back into dollars, U.S. interest rates must rise relative to German and Japanese rates, and the respective gaps in inflation rates must narrow. As the economies of Germany and Japan slow, interest rates are expected to follow, as evidenced in already lower bond yields relative to short-term rates. If the average current account balance of the seven big industrial economies falls to only 0.6 percent of their collective GNP in 1991, as forecast, more stable exchange rates are likely to emerge. And if the demand for capital by the United States continues to subside, the supply of funds to the Middle East and Central Europe should correspondingly ease. *[Alberto Jerardo (202) 219-0717]*

World real economic growth

Calendar year	1990	1991	1992
		Percent change	
World	1.3	1.0	3.3
World less U.S.	1.4	1.4	3.3
Developed countries	2.4	1.3	3.1
DC's less U.S.	3.3	2.0	3.1
United States	1.0	-0.4	3.2
Canada	0.9	-0.5	3.9
Japan	5.6	3.1	3.8
EC-12	2.8	1.7	2.9
Developing countries	1.8	2.6	5.3
Latin America	-1.1	1.5	3.6
Mexico	2.6	3.4	4.6
Asia	5.5	5.9	6.2
South Korea	9.0	7.8	7.8
Taiwan	5.1	5.8	6.8
China	4.4	5.7	6.3
Middle East	-6.5	-7.9	8.8
Africa	2.9	2.8	2.6
Central Europe	-6.2	-4.4	-0.5
USSR	-4.8	-5.1	-1.0

Sources: History: IMF, *International Financial Statistics Yearbook*; country projections: Project LINK (March 1991).

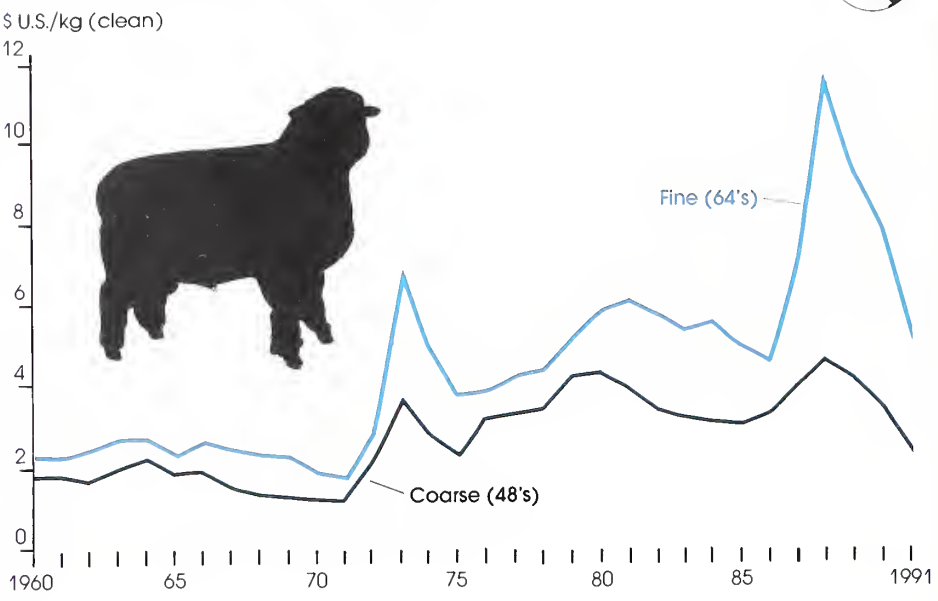
Wool Markets in Disarray

On February 1, 1991, the Australian Government canceled wool auction sales for 3 weeks, and on February 11 suspended the Australian Wool Corporation's (AWC) reserve price scheme until the end of the marketing year on June 30. Following Australia's lead, on February 12 the New Zealand Wool Board eliminated its market reserve price and minimum price schemes for the balance of the season. The two Boards will thus no longer operate price support levels at auction and buy wool that fails to reach these levels. As a result, when wool sales resumed on February 25, no market price intervention program was in place for the first time in nearly 20 years in Australia and 40 years in New Zealand. The freely operating wool market determined the price of wool according to supply and demand factors.

As expected, the Australian market indicator price dropped from its close of A704 cents to A454 cents per kilogram clean, or by a sharp 35 percent (*10*). The drop in New Zealand's market was less drastic. The price fell from NZ395 cents to NZ357 cents on the first trading day, representing a real fall in the price to wool growers from the minimum guarantee of NZ485 cents to NZ357 cents, or nearly 26 percent (*8*).

By the end of the first week of free market wool sales in Australia, the market indicator price had dropped to A428 cents (US$3.35), while that of New Zealand was NZ347 cents (US$2.16). In the second week, prices closed at A445 cents and NZ357 cents. In South Africa, the wool market reopened in the first week of March with prices generally following the Australian market. The South African market indicator price fell SA403 cents to close at SA947 cents (US$3.68).

FIGURE 1 **Wool Prices Ran Up in 1987**



In Australia, the Government agreed to lift the ceiling on its guarantee of AWC borrowings to only A$3.5 billion and extend its guarantee on all borrowings beyond 1992 until debts were reduced. Also, the Government agreed to contribute A$300 million toward a supplementary payments scheme to growers who sell their wool during the remainder of the season. Supplementary payments will make up the difference between the new auction price and the A700-cent reserve price level. The Government also agreed to provide additional funds for debt reconstruction, farm improvement, household support, counselling, and assisting individual farmers.

After deliberating what course to follow in the new marketing year beginning July 1, the Government on May 1 announced the permanent abolition of the wool price scheme. Moreover, the Government announced a reorganization of the industry, replacing the old AWC with three new statutory bodies: a new institution called the Australian Wool Corporation to be responsible for marketing and quality control; a Wool Research and Development Corporation; and a Wool Realization Commission, which will dispose of stocks. Sales from the stockpile, which had been frozen in February, will resume on July 1, with revenues going to pay off the old AWC's back debt (*1*).

Effect of Wool Price Liberalization

Wool price liberalization is considered a significant forward step in providing substantial benefits for the industry, the individual growers, users, and taxpayers in Australia, New Zealand, South Africa, and elsewhere. In addition, the new policies ended uncertainties created in wool markets that had induced most buyers to wait before making purchases.

Fluctuations in wool prices are nothing new. They made a dramatic jump from 1986 to 1988, to the highest level in 30 years (fig. 1). In May 1988, the price of fine wool used for high-quality clothing and apparel peaked at US$13.04 per kilogram clean weight, CIF London. The price was triple the level of the trough 21 months earlier (August 1986). The price for coarse wool used mainly for carpets and rugs rose a relatively

modest 60 percent from January 1986 to October 1988. The 1986-88 price increase for fine wool was still below the trough-peak surge that occurred during the international commodity price boom of the 1973 oil crisis. Between 1971 and 1973, the price for fine wool nearly quadrupled and coarse wool tripled.

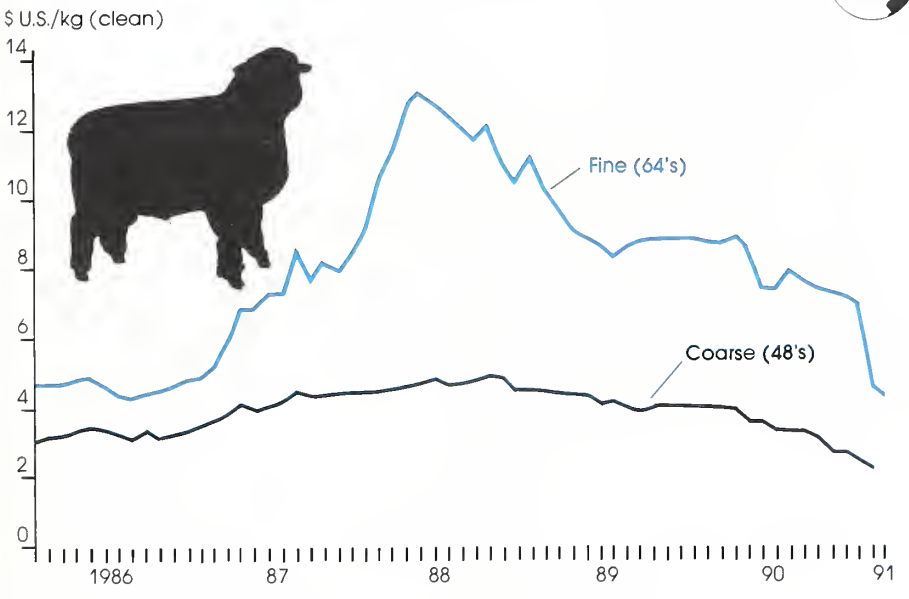
High prices for wool, among other factors, have exerted a strong downward pressure on the quantity demanded since June 1988. The price level reached in 1988 was unsustainable, causing a slump in the market, especially for fine wool. Between May 1988 and January 1991, prices declined 43 percent for fine wool. Between August 1988 and January 1991, prices declined 47 percent for coarse wool (fig 2).

Australia's Role in Wool Markets

Australia, the largest wool producer and exporter, takes a leading role in setting prices in world markets (figs. 3, 4, and 5). At the beginning of the 1988/89 season, the AWC set the minimum support price at A870 cents per kilogram clean for a weighted average of 13 wool categories. The new AWC support price was 35 percent higher than a year earlier, and 85 percent above 1984/85. The AWC's justification for raising the price floor was to cope with the depreciated value of the Australian dollar, especially in Australia's main wool markets in Western Europe. Over the last 5 marketing years (1984/85 to 1989/90), the depreciation of the Australian dollar was 42.8 percent against the German Mark, 41.7 percent against the yen, 25.9 percent against the pound sterling, and only 1 percent against the U.S. dollar.

The high Australian support price spurred domestic and foreign production. The increased production, combined with a slowdown in world consumption, forced the AWC to accumulate stockpiles of surplus wool to protect the price support level from moving below its set level. On May 31, 1990, the Government decided to intervene by lowering the floor price for wool 20 percent to A700 cents. In addition, the Government raised the wool levy charged by the AWC from 8 percent to 18 percent of growers' revenue on June 1, 1990.

FIGURE 2 **Recently, Wool Prices Have Plunged**



CIF, London.

The Government's objective was to increase significantly wool sales and stabilize prices. However, the new measures proved to be insufficient. In the 1990/91 season (which started in July 1990), demand was sluggish and prices continued to move only a few cents above the A700-cent floor price, indicating a fundamental weakness in the price structure. Consequently, the AWC was obliged to purchase more wool, swelling its stockpiles from 3.06 million bales on July 1, 1990, to nearly 4.8 million in January 1991. Moreover, financial activity by the AWC in defense of floor prices depleted its huge reserves, and it resorted to borrowing, exceeding the maximum Government guarantee level of A$2.5 billion, and reaching an all-time high of A$2.8 billion.

In October 1990, the Government again increased the wool levy, from 18 percent to 25 percent of growers' revenue. The new legislation also included a provision for a maximum wool levy up to 30 percent and a surcharge on the wool tax of up to 20 percent from the beginning of the 1991/92 season, if necessary. In November 1990, the Government approved a proposal to slaughter 20 million head out of a national flock of 173 million, and imposed quotas to cut overall wool production by 25 percent over the 12 months beginning July 1991.

The AWC reportedly wanted the floor price scheme to continue, but the Government balked at forecasts from the Australian Bureau of Agricultural and Resource Economics that stockpiles would rise from 4.8 million bales to 8.7 million over the next 2 years, requiring an increase in the AWC's federally guaranteed debt from A$2.8 billion to about A$4 billion (*5*).

Changes in Market Fundamentals

The decline in wool prices since May 1988 was basically a result of changes in supply and demand fundamentals. Usually, when demand is exceptionally high, a rapid increase

FIGURE 3 **Wool: Australia Top Exporter, EC Top Importer**

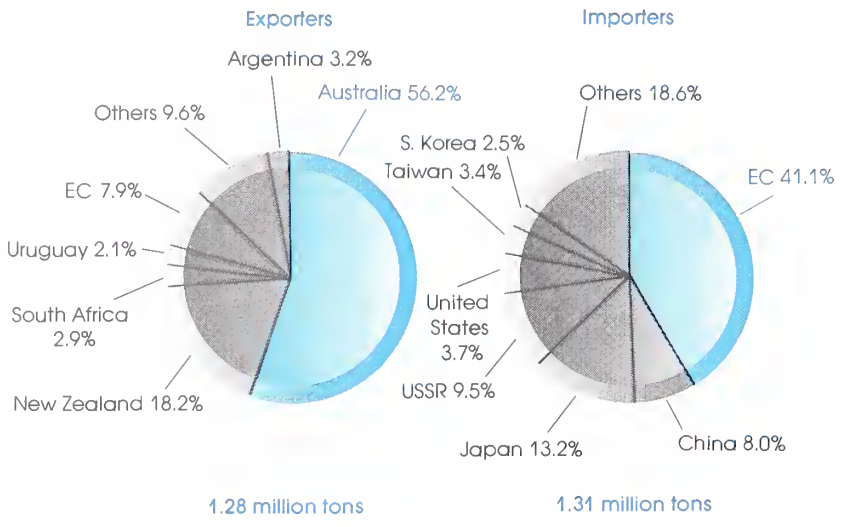
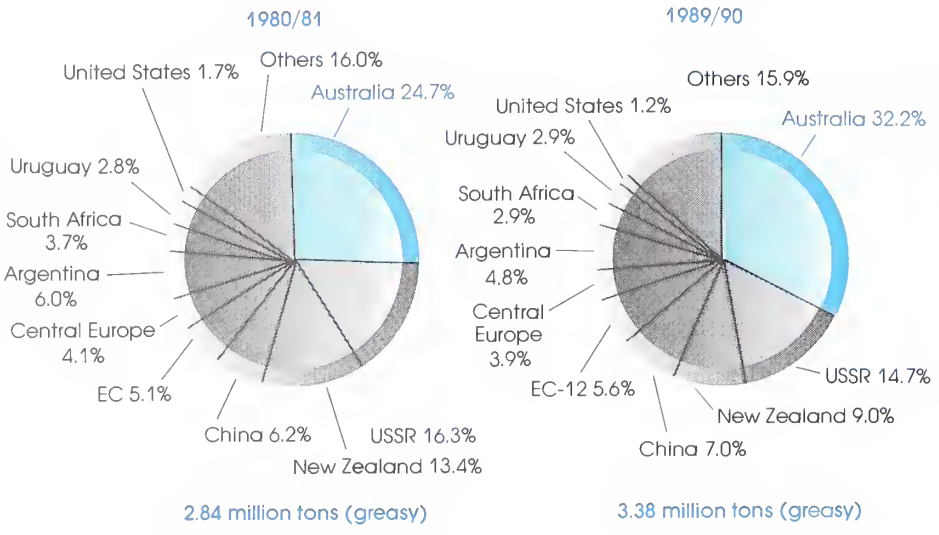


FIGURE 4 **Australia Produced Nearly a Third of the World's Wool in 1989/90**



in price acts as a useful rationing device; some buyers drop out of the market and some substitute other fibers for wool. Five major factors can be pinpointed as influencing the current world wool market: (1) A deceleration of economic growth rates in the Organization for Economic Cooperation and Development (OECD) countries; (2) the economic situation in China, the USSR, and Central Europe; (3) competition from man-made fibers; (4) record world wool stockpiles; and (5) actions of the AWC.

Deceleration in OECD Economic Growth Rates

A slowdown in economic growth in OECD countries, the principal wool consumers, is usually accompanied by decreasing expenditure on clothing in general and wool clothing in particular. For example, the recent deceleration in economic growth rates in Western Europe depressed consumer expenditures for clothing. This was reflected in a 5-percent decrease in wool textile manufacturing in the first quarter of 1990 for the 11 OECD countries for which data are available (*11*). The industry contraction started in worsted processing, but later spread to combing and weaving.

Consumption of raw wool in the EC, the world's largest single market, declined by 3.7 percent from its level 2 years earlier (table 1). Japan also cut imports because of its large wool reserves and increased imports of intermediate and finished wool textile products from low-cost manufacturers in other Asian countries. In 1989, U.S. and Japanese wool use was low, 5.5 and 4.0 percent, respectively, below 2 years earlier. The setbacks in Europe and Japan substantially built up wool stocks at the producer, industry, wholesaler, and retailer levels, and caused a further slowdown in the demand for raw wool.

The Economic Situation in China, the USSR, and Central Europe

Recent political changes in China, the USSR, and Central Europe created a chain of economic events with a substantial impact on world demand for wool. Consumption in these countries was 40 percent of the world total in 1989, down from 41.5 percent in 1988 (table 1). Import demand was 21.3 percent of the

Table 1—Consumption of virgin wool by the wool textile industry at the spinning stage

Country	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
						1,000 tons (clean basis)					
Argentina	26.4	23.2	16.2	24.9	23.1	26.7	24.6	27.3	26.3	21.3	21.2
Australia	30.1	30.2	29.5	28.6	31.1	18.9	20.6	20.7	20.3	20.5	17.9
Belgium-Lux	32.8	35.8	30.4	31.4	33.5	40.0	38.1	36.6	31.0	34.0	42.0
China	94.8	122.6	144.6	174.8	171.2	149.2	188.6	243.9	254.1	298.7	243.5
Czechoslovakia	21.8	27.1	20.9	22.2	22.6	20.1	21.4	21.9	21.8	24.9	25.8
East Germany	18.0	19.0	19.6	17.0	17.5	21.5	19.4	20.2	19.8	22.5	22.0
France	108.2	110.0	109.1	99.2	95.7	44.6	42.7	37.8	35.8	32.7	28.2
West Germany	61.2	59.6	50.1	41.2	37.1	63.6	62.9	59.8	62.3	58.0	60.1
India	30.9	32.3	33.3	37.6	39.1	34.0	35.0	34.5	33.0	33.7	32.2
Italy	136.7	140.9	136.0	119.2	114.4	127.1	130.1	125.0	140.2	139.9	133.6
Japan	122.4	106.7	103.3	111.9	100.3	118.1	123.2	113.6	126.8	126.3	121.9
New Zealand	17.2	16.0	19.9	19.8	19.8	23.3	25.4	22.4	21.5	18.8	19.2
Pakistan	18.0	21.3	21.9	18.3	24.0	16.4	13.6	16.2	19.5	25.6	24.5
Spain	18.7	20.2	22.5	23.0	20.0	20.0	21.5	24.8	19.2	16.9	16.6
South Korea	26.9	28.1	29.7	29.1	27.6	24.4	27.6	39.5	46.3	54.2	52.6
USSR	348.2	331.4	342.0	333.1	360.6	302.9	308.3	308.6	324.1	320.0	333.9
Taiwan	14.7	14.9	14.0	16.8	18.2	18.1	14.2	23.9	26.1	19.9	20.9
United Kingdom	105.9	92.3	88.2	85.5	87.3	78.0	77.0	78.0	87.0	87.6	80.7
United States	53.9	56.6	63.2	53.3	64.0	68.3	51.8	62.1	62.5	53.0	59.0
Sub-total	1,287	1,288	1,294	1,287	1,307	1,215	1,246	1,317	1,377	1,408	1,356
World total 1/	1,558	1,574	1,581	1,556	1,566	1,594	1,625	1,700	1,744	1,764	1,711
Total EC-12 2/	470.8	462.5	435.6	426.7	415.1	414.0	415.9	407.3	416.0	407.6	401.1
Central Europe	114.4	121.2	113.9	109.8	106.6	119.3	116.9	114.1	108.8	114.8	108.0
						Percent					
EC-12	30.2	29.4	27.6	27.4	26.5	26.0	25.6	24.0	23.9	23.1	23.4
USSR	22.3	21.0	21.6	21.4	23.0	19.0	19.0	18.2	18.6	18.1	19.5
China	6.1	7.8	9.2	11.2	10.9	9.4	11.6	14.3	14.6	16.9	14.2
Central Europe	7.3	7.7	7.2	7.1	6.8	7.5	7.2	6.7	6.2	6.5	6.3
Japan	7.9	6.8	6.5	7.2	6.4	7.4	7.6	6.7	7.3	7.2	7.1
United States	3.5	3.6	4.0	3.4	4.1	4.3	3.2	3.7	3.6	3.0	3.4
Others	22.7	23.7	23.9	22.3	22.2	26.5	25.9	26.5	25.9	25.2	25.9

1/ 47 countries prior to 1984, 66 major countries after 1984. 2/ EC-10 prior to 1982.
Source: Wool Statistics 1989-90 and previous issues. Commonwealth Secretariat International Wool Textile Organization and International Wool Study Group, London, June 1990.

world total, down from 25.7 percent in 1988.

From 1978 to 1988, China had been the fastest growing wool market and importer in the world. However, following the Tienanmen Square events of June 1989, China's import demand for raw wool and wool semi-manufactures (tops, yarn, and fabric) was weakened by foreign exchange shortages. Consequently, during the 1989/90 season China's wool imports dropped by 44.3 percent, forcing its wool textile industry to operate far below capacity (table 2). In addition, a large proportion of wool tops and yarns that were ready for shipment to the Chinese market in 1989/90 ended up instead in storehouses, or were sold below cost. This created excess capacity in several wool processing countries, and cut their import demand for raw wool.

A shortage of foreign exchange also hampered the USSR, where wool imports in 1989 were approximately 15 percent below 2 years earlier (table 2). Before 1989, wool imports had not grown sufficiently to compensate for the declining size of the national flock and domestic production. In addition, the USSR failed to repay some debts to wool exporters in Australia and New Zealand, causing trade to stop near the end of the 1989/90 season. In Central Europe, import demand for wool decreased 9.3 percent below the previous year due mainly to political and economic upheavals, and lack of foreign exchange.

Competition From Other Fibers

In reaction to the record prices for wool, fabric manufacturers switched to substitutes containing mainly

cotton and man-made fibers. At the same time, technical developments in the manufacture of man-made fiber and in the processing of cotton knitwear provided a wide range of texture choices and caused more substitution.

Synthetic fibers are the major competitor for fine wool types in manufacturing worsted yarn. As a result, for the first time in 6 years, consumption of man-made fibers has gained at the expense of natural fibers, to the point that overall wool consumption in nine reporting countries was 2 percent lower in the first quarter of 1990 than in the first quarter of 1989, with a corresponding rise in competing man-made fibers (*11*).

Record World Wool Stockpiles

By the end of the 1989/90 season, world wool stocks rose to nearly four times their beginning level, exerting substantial downward pressure on prices. In Australia during this period, wool stocks rose an unprecedented 16 fold, from 188,300 bales to 3,037,381 bales. These stocks far surpassed the 1974/75 record of 1,616,200 bales. New Zealand faced a similar situation, with stocks held by the Wool Board quintupling during the season, and reaching the highest level since 1982. Also in South Africa and Argentina, stocks rose substantially (*11*).

Since the beginning of the current season on July 1, 1990, till the end of January 1991, wool stockpiles continued their trends. In Australia, stocks reached 4,765,627 bales, in New Zealand nearly 700,000 bales, and in South Africa 272,989 bales (*10*).

Action of the Australian Wool Corporation

Wool marketing in Australia used to be conducted directly by brokers representing producers through auctions to the agents of overseas buyers. Auction sales were run privately and freely, not subject to direct export regulations or control. In 1973, however, the Australian Wool Board joined the Australian Wool Commission to establish the AWC.

The AWC took a leading role in determining and operating a reserve price scheme for individual qualities of wools. It established the floor price in consultation with the Wool Council of Australia, which represents the 60,000 growers who funded the effort by contributing a percentage of their wool income as a levy. These levies were used to promote marketing, research, and to finance the floor price scheme for growers. The AWC bought wool at auction when bidding was below the floor price, and resubmitted the stockpiled wool to the market when prices improved or the agreed-upon price was reduced. Wool boards in New Zealand, South Africa, Argentina, and Uruguay usually maintained reserve prices at levels equivalent with the AWC, after adjusting for quality differences and the conversion factor to clean wool.

Outlook for Wool Supply and Demand

In the short run, factors influencing supply/demand forces in the international market for raw wool indicate wool prices will remain low. On the demand side, prospects for import growth in major markets of Western Europe, Japan, and the United States remain dim. With current stocks high in relation to world production and consumption, any pickup in demand along the wool textile pipeline should be reflected relatively slowly in auction trade offerings and prices. Labor costs in the textile industry favor imports of intermediate textile goods and finished clothing and apparel. In addition, demand by the critical importing regions of China, the USSR, and Central

Table 2—Major importing countries of virgin wool (excluding wool on the skin)

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
					Actual weight in tons					
Belgium-Lux	2,217	33,537	30,940	33,746	46,863	55,157	58,007	64,035	66,544	69,384
China	29,110	44,580	63,920	50,600	47,255	113,375	152,234	152,504	187,411	104,388
France	117,187	124,402	111,536	108,901	127,844	131,679	131,631	118,489	114,656	125,981
West Germmany	79,489	71,099	61,411	61,402	74,966	77,164	72,803	79,673	75,920	74,900
India	13,050	17,971	13,013	19,800	19,640	21,200	32,509	27,934	30,000	25,000
Italy	117,685	113,544	90,453	65,934	105,871	120,272	109,194	122,174	113,968	106,825
Japan	175,564	167,414	179,330	161,361	184,236	183,987	176,792	204,353	174,788	172,996
South Korea	22,799	29,208	28,764	29,865	27,582	31,318	38,249	44,742	37,761	32,236
USSR	124,170	126,294	125,229	149,521	89,570	109,143	115,251	133,999	114,325	124,270
Taiwan	27,815	27,751	31,003	34,912	35,851	40,572	49,687	51,542	35,540	45,038
United Kingdom	95,535	107,937	100,956	109,170	117,752	128,280	117,642	138,906	128,051	110,178
United States	33,028	43,650	36,139	36,036	41,948	35,117	43,994	47,659	43,648	4,857
Sub-total	877,649	907,387	872,694	861,248	19,378	1,047,264	1,097,993	1,186,010	1,122,612	996,053
World total	1,119,684	1,165,741	1,093,048	1,088,375	1,137,406	1,261,186	1,324,014	1,413,839	1,377,789	1,241,214

Source: Wool Statistics, Commonwealth Secretariat International Wool Textile Organization, and International Wool StudyGroup, London, June 1990.

FIGURE 5 **Australia Dominates in Fine Wool Production**

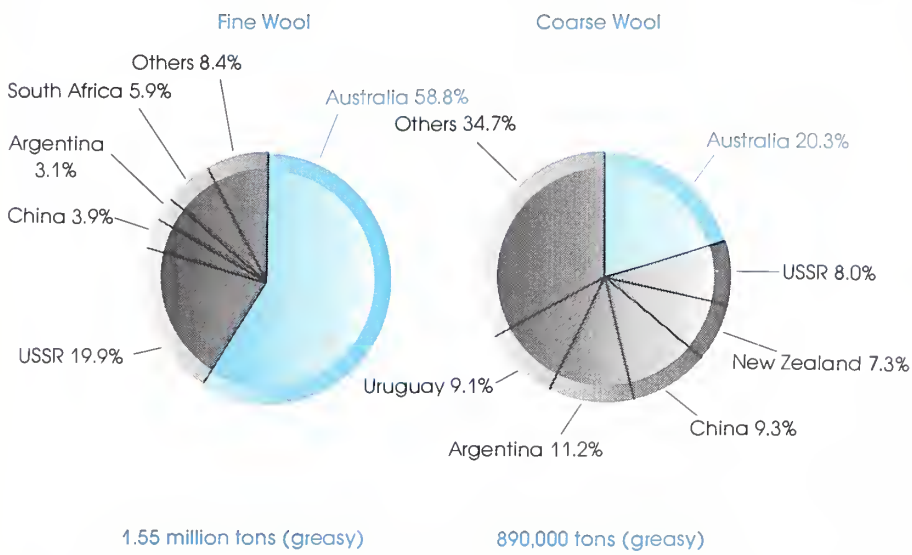
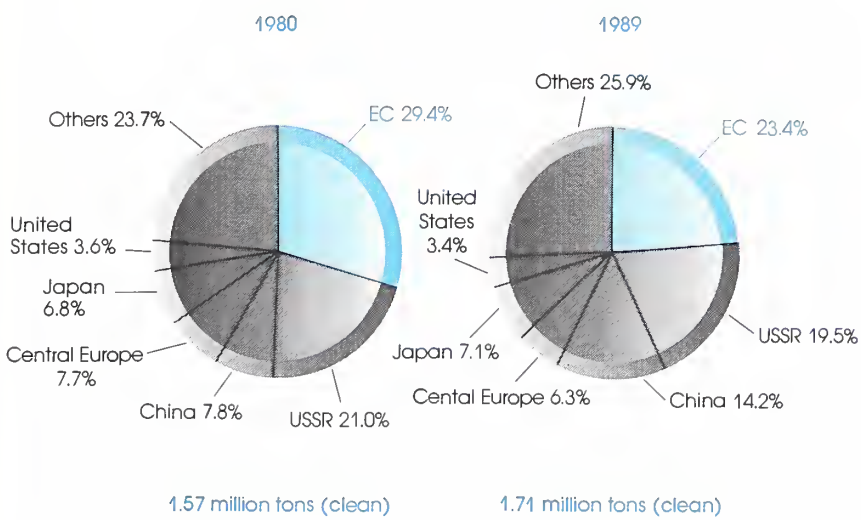


FIGURE 6 **Raw Wool Consumption Expands and Shifts**



Europe, while less predictable, has been sluggish and is likely to remain so during the balance of the 1990/91 season, mainly due to slowdowns in economic activities and lack of foreign exchange.

On the supply side, world production is forecast to increase by nearly 1 percent at the end of June 1991 over the previous year (*2*). Over the longer run, world wool production will most likely decrease because of the Australian Government's abolition of the floor price scheme, cutting the size of the national flock, and imposing production quotas. These measures will most likely induce a major structural adjustment of the wool industry in Australia and other major producers. In Australia, the direct impact will be to reduce farmers' returns from wool, restrain growth in domestic production, and make growers switch to growing other, more profitable crops over the next few years. Wool production is expected to increase in China, the EC, and other small markets. However, these countries' wool production is mainly of coarse types. Consequently, imports of fine types will accelerate, where consumers demand more and higher quality textiles as their incomes rise. *[Fawzi A. Taha (202) 219-0610]*

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Chilean Fruit Industry Thriving

Chile's emergence as a supplier of fresh fruit to the world market has been extraordinary. In 1974, Chile's fruit exports were a modest 57,000 tons, while in 1986 they had grown 1,182 percent to 674,000 tons (table 1). Over the same period, fresh fruits went from being 17 percent of the total value of Chile's agricultural exports to 45 percent.

Table 1—Chile's agricultural and fresh fruit exports

Year	Total agriculture	Fresh fruit1/	Fresh fruit	Share2/
	Thousand dollars		*Tons*	*Percent*
1974	113,681	19,254	56,908	17
1975	180,886	39,595	91,586	22
1976	226,362	54,750	144,139	25
1977	300,018	55,051	143,753	18
1978	375,710	96,845	36,834	26
1979	na	na	na	na
1980	na	na	na	na
1981	na	na	na	na
1982	660,214	215,016	383,132	33
1983	676,609	217,231	431,445	32
1984	775,634	300,153	na	39
1985	861,258	358,983	539,776	42
1986	1,083,957	484,530	674,103	45

na = Not available. 1/ Fruits included are oranges, tangerines, or mandarins and clementines, other citrus fruit, fresh bananas, fresh apples, fresh grapes, and edible nuts, fresh or dried. 2/ Percent of total value of agricultural exports consisting of fruit.
Source: (2)

Capacity and Trends in Production

Chile's fruit-growing area has increased dramatically since 1974. In that year, 65,670 hectares (ha) were devoted to fruit and tree nut production (almonds, cherries, plums, apricots, peaches, apples, nectarines, lemons, quinces, oranges, walnuts, olives, avocados, pears, and table grapes). By 1986, the area had almost doubled to 130,000 ha. Fruit production nearly tripled, from 559,550 tons in 1974/75 to 1,463,000 tons in 1986/87 (*1*). 1/

Much of the increase in area was for table grapes, from 4,250 ha in 1974 to 36,000 ha in 1986 and 47,700 ha in 1989 (*1, 6*). Production increased from 59,100 tons in 1974/1975 to a 1989/90 crop of 615,000 tons (*7*, p. 25). Production will continue to increase because approximately a quarter of planted land in table grapes has not reached bearing age. Of all fruits produced in Chile, table grapes account for the most land. The majority of exported table grapes are destined for the United States. Chile is also the largest supplier of U.S. table grape imports.

From 1974/75 to 1989/90, production of apples jumped from 125,000 tons to 755,000 (*7*, p. 25). Data on planted land and tree ages indicate that Chilean apple production could increase 50 percent over current levels in the next 10 years. A major export crop, the apples are sold mainly to Europe. While the country's primary Southern Hemisphere competitors are South Africa, Australia, New Zealand, and Argentina, Chile has surpassed them in capturing shares of the European Community (EC) winter market. Major fruits produced for export, besides table grapes and apples, include peaches, nectarines, and pears.

Chile has a number of natural advantages in fruit production. Geographically it encompasses a variety of climates and therefore produces a large number of products at different times of the year. And Chile is relatively isolated physically, providing excellent natural protection from pests and diseases. To the north is the Atacama Desert, to the east the Andes Mountains, and to the west the Pacific Ocean.

International Competitive Position

Because Chile is in the Southern Hemisphere, its deciduous fruit ripens during the U.S. and European winter. While this lessens competition to the Chileans from their export markets' domestic producers, competition is still an issue. Table grapes overlap U.S. production early and late in the season. Due to section 8e of the Agricultural Marketing Agreement Act of 1937, grapes imported into the United States have to meet the same quality standards applied to Coachella Valley (California) growers by the Federal Marketing Administration for Desert Grapes.

1/ These tentative data were computed by the Chilean Bureau of Agricultural Planning (ODEPA) on the basis of the Development Corporation (CORFO) real estate registers, and regional information, modified according to National Bureau of Statistics (INE) surveys of April 1985.

However, the emergence of Chile as a supplier of fresh grapes may have enhanced demand for U.S. grapes. U.S. consumers became accustomed to year-round availability of grapes and consequently increased consumption in all seasons. Per capita consumption of table grapes in the United States increased from 2.68 pounds per year in 1973 to 8.03 pounds in 1988 (*5*, p.22). However, Chilean production has increased to the extent of raising concern that it may be competitive with U.S. fruit.

Worldwide production of apples is growing faster than demand (*4*), increasing competition for markets. Apples from Chile compete with stored apples in the Northern Hemisphere. Nevertheless, the United States offers strong competition to Chilean apple production. A recent study of the major foreign U.S. apple markets of Canada, the United Kingdom, Singapore, and Hong Kong indicated that the emergence of Chile as a major world supplier has not substantially altered the U.S. position in these markets regarding price or market share competition. Consequently, as these markets grow, the United States would be expected to increase its share as it did before Chile emerged in the international apple market (*2*).

To gain market share and to combat unfair trading practices, the United States is spending money, which is matched by grower groups, to promote its exports of apples, grapes, peaches, nectarines, pears, and cherries through the Market Promotion Program. Domestic expenditures on promotional activities are also increasing. Chile, in contrast, spends little to directly promote exports. Pro-Chile, a branch of the Ministry of Foreign Affairs, promotes exports by gathering iinformation and coordinating marketing activities with industry.

Chilean Domestic Policy

The Government of Chile plays a small direct role in supporting its fruit sector. Required reports and documents are kept relatively simple and accessible to exporters. The Chilean Government examines foreign regulations regarding fertilizers, pesticides, post-harvest treatments, and labeling standards, then disseminates the information to exporting companies and growers. Chemical residue and labeling standards that will meet the regulations of the countries Chile exports to are recommended. By helping growers and exporters conform to international regulations, the Government facilitates fruit exports.

On January 18, 1991, minimum quality requirements for winter fruit were announced by Chilean grower associations. These requirements include standards for size, maturity, and general conditions and are specified by fruit type. This quality control program is being overseen by technical experts at a Chilean agricultural university.

Chile's free market orientation is manifested in the fruit sector by growers working directly with export companies, rather than the Government, to aid in both the production and marketing of their fruit. Growers are free to choose the export company they wish to represent them. One-year contracts are the norm, making it possible for growers to readily change companies. Export companies often provide technical assistance and financing. They usually provide university-trained personnel to visit growers regularly to help solve production problems. Exporting companies usually negotiate lines of credit with banks and, in turn, extend credit to growers. Terms and early availability of credit influence growers' choice of an exporter.

The costs of fertilizers and chemicals are rising along with taxes and the value of land. As a result, there are downward pressures on profits for the individual grower.

Access to Markets and Future Industry Trends

Several promising signs are on the horizon for the Chilean fruit industry including the opening of Central European markets and the rising incomes of Asian countries, particularly Taiwan and Singapore. These areas could well become major new markets for Chilean fruit. Also, the industry is evolving into more of an industrial concern. The country, partly through joint ventures with Europe and the United States, is expanding the infrastructure to produce canned fruit, along with juice concen-trate and dried and frozen fruit. The Chilean industry also expects to increase the demand for fresh fruit in established markets by more aggressive promotion efforts and a more uniform quality standard for exports. *[Amy Sparks (202) 219-0885]*

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World Fertilizer Use Continues Up

World total fertilizer use increased steadily over the past three decades, and is likely to continue to grow, though at decreasing rates. The increase was fivefold between 1960 and 1988, from 31.0 million tons in 1961 to 145.6 million tons in 1988. In 1989, however, the use dropped to 127 million tons. The annual growth rate of fertilizer use dropped from 11 percent in the early 1960's to a low of 2 percent in the early 1980's, as fertilizer prices, prompted by high petroleum prices during the second energy crisis, rose in 1980 and 1981. Since then, fertilizer use has expanded at 3 to 6 percent per year, but then dropped by 12 percent in 1989 (see table).

Nitrogen fertilizers represent today about 55 percent of all fertilizer use, followed by phosphate with 26 percent and potash with 19 percent. Three decades earlier, each fertilizer nutrient contributed about one-third to the total. The relatively greater use of nitrogen fertilizers has environmental implications because such fertilizers have been found to be a major source of nitrates in groundwater in areas where such pollution has occurred.

Fertilizer application rates in the developed countries seem to have peaked about 1980, except for Australia and New Zealand, where the peak was reached in 1973. Peak application rates varied across these regions. In Western and Central Europe, they reached 240 and 220 kilograms per hectare (kg/ha) of arable land respectively, but in North America and Australia and New Zealand, the maxima were 93 and 38 kg/ha. In East Asia, however, the region that groups principally Japan, the two Koreas, and Taiwan, fertilizer application rates reached 383 kg/ha as early as 1979, dropped to a low of 328 kg/ha in 1982, and then steadily climbed again to 360 kg/ha in 1987. The much higher application rates in Europe and East Asia, as compared with other regions, reflect primarily the difference between intensive and extensive agricultures.

After peaking, the fertilizer use per unit of arable land remained either constant or declined. It declined in particular in North America, Central Europe, and Australia and New Zealand, but remained nearly constant in Western Europe at close to 240 kg/ha and in East Asia at 360 kg/ha. There are three reasons for leveling off or decline in application rates of fertilizers and other agricultural chemicals. The most important one is a matter of economics, rates reaching the point where it becomes no longer profitable to use additional doses of chemicals. The other two reasons are an increasing concern with environmental impacts of heavy use of agricultural chemicals, and technological progress in the delivery of the chemicals to the plant, allowing more effective application with reduced quantities.

In the developing countries and in the USSR, application rates are still rising, with China showing the fastest increase, even though its rate of application has surpassed that of Western Europe. In 1988, China's average application rate reached 262 kg/ha, as against 229 kg/ha in Europe. One exception is Sub-Saharan Africa, where fertilizer use remains at the low level of about 12 kg/ha, and crop yields remain static and low.

Throughout the world, there exists a strong correlation between fertilizer use and crop yields. Generally, increases or decreases in cereal yields go in tandem with fertilizer application rates, though in some countries increases in cereal yields show a certain lag behind growth in fertilizer application rates.

World fertilizer prices, which rose sharply during the two recent energy crises, one in 1974 and the other in 1980, fell as steeply once the emergency was over, reaching the lowest point in 1984 and 1985. Since then, however, the prices have steadily risen and the Middle Eastern war of this year helped to improve the price prospects, particularly insofar as, for the time being, Iraqi and Kuwaiti fertilizer production facilities are out of commission. *[Francis Urban (202) 219-0717]*

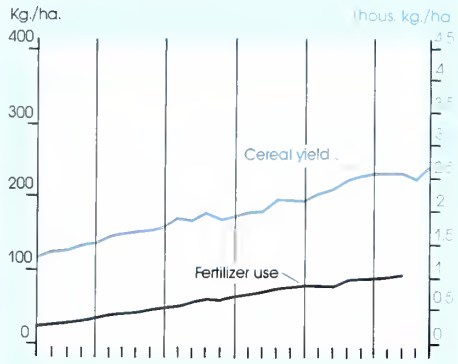
World fertilizer use, 1970-89 1/

Year	Nitrogen	Phosphate	Potash	Total	Growth rate
		Million metric tons 2/			*Percent*
1970	31.8 (46)	21.1 (30)	10.4 (24)	69.3 (100)	8.1
1975	44.4 (49)	25.6 (28)	21.4 (23)	91.4 (100)	5.7
1980	60.9 (52)	31.7 (27)	24.3 (21)	116.9 (100)	5.0
1985	69.8 (54)	23.2 (26)	25.6 (20)	128.6 (100)	2.0
1986	71.7 (54)	34.7 (26)	26.2 (20)	132.6 (100)	3.1
1987	76.0 (54)	36.9 (26)	27.5 (20)	140.5 (100)	6.0
1988	79.6 (55)	38.0 (26)	28.0 (19)	145.6 (100)	3.6
1989	69.7 (55)	33.2 (26)	24.1 (19)	127.0 (100)	-12.8

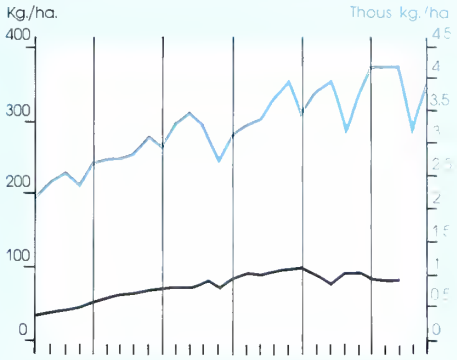
Note: Parentheses indicate percent share. 1/ N, P2O5, and K2O, respectively. 2/Annual rate of growth from the preceding indicated year.
Source: FAO Fertilizer Yearbook. Rome: various issues.

Fertilizer Use and Cereal Yields, 1961-89

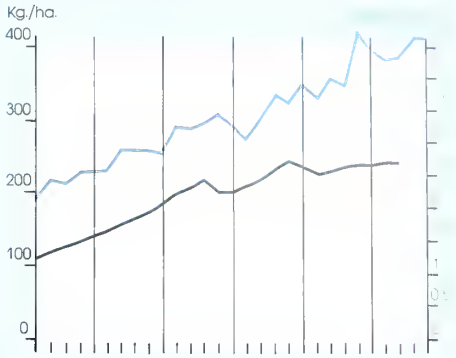
World



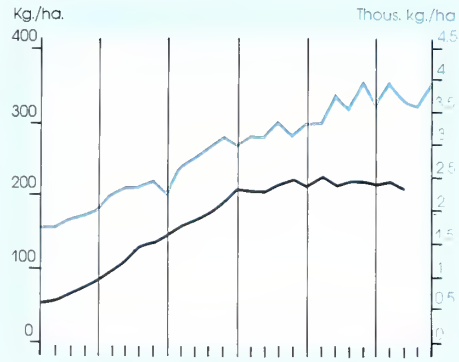
North America



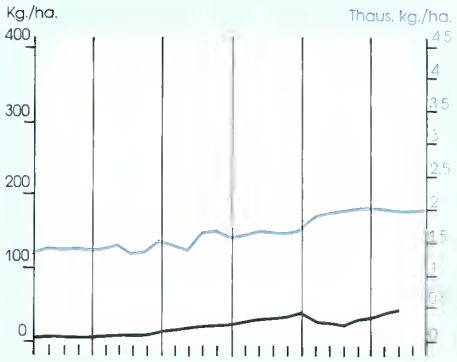
Western Europe



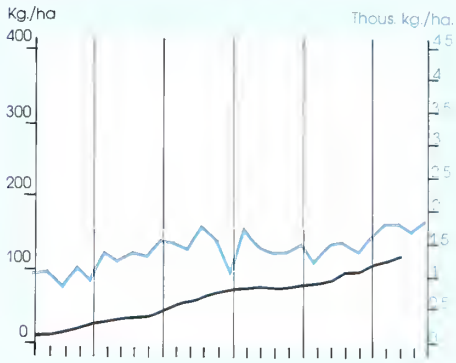
Central Europe



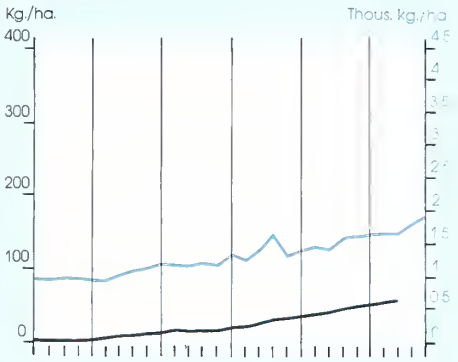
South America



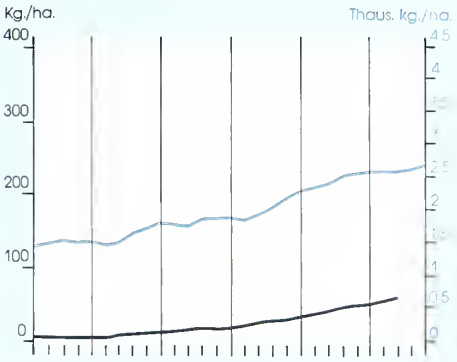
USSR



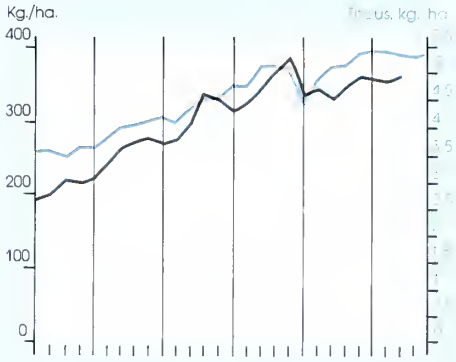
South Asia



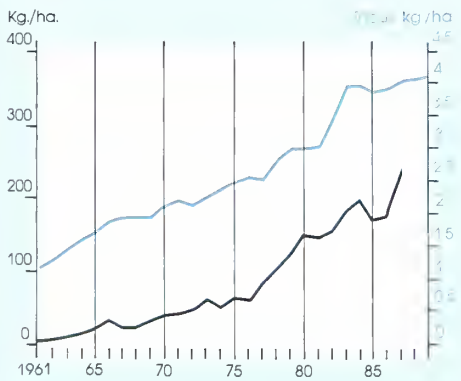
Southeast Asia



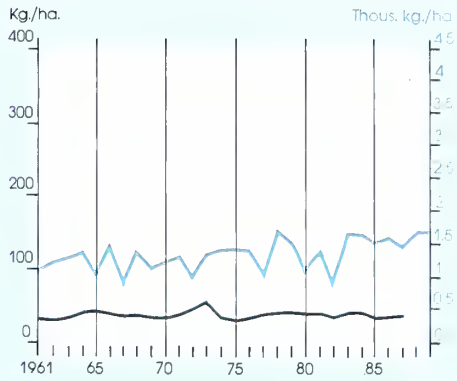
East Asia



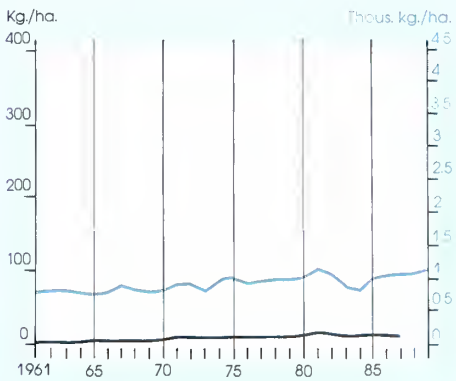
China



Australia and New Zealand



Sub-Saharan Africa



Animal Welfare Legislation Alters European Egg Production

Confinement buildings and cage housing became fixtures of egg production in the United States in the 1940's and in Western Europe and elsewhere a decade later. Recently, however, caging has been challenged in Western Europe by animal welfare activists. Resulting legislated limits on caging put affected farmers at a competitive disadvantage to those elsewhere using cages to the fullest.

Egg Industry Shifts to Cages

Western Europe's commercial egg industry nearly completed its shift to cage housing two decades ago. For example, in the early 1960's only about 20 percent of layers in the United Kingdom were caged, usuall in single-bird cages (fig. 1). Cages were adopted by farmers because of cleaner eggs and less cannibalism and feather pecking. The cage system also freed the farmers from the problem of land becoming "fowl sick" through harboring disease organisms in the droppings.

By the mid 1970's, the proportion of layers housed in cages in the United Kingdom had risen to over 90 percent. Capital costs were further reduced and output increased by putting several birds in a cage. Feeding, watering, and egg collection can all be done automatically. With higher stocking densities the houses remain warmer during the winter. Feed use rises 1.5 percent for each 1 degree C that the temperature falls below 20 degrees C, the optimum for feed conversion efficiency (*6*).

All these economic advantages contributed to the rapid shift of the industry to cages. However, some people argue that the restricted movement in cages harms layer welfare. The birds can barely preen, can stretch their limbs only to a small extent, and can barely turn around. They cannot dust bathe, the method by which a bird cleans itself. There is no real exercise in the cage.

The conditions led to a public debate about the welfare of hens. Subsequent legislation increased cage space per bird or banned cages altogether.

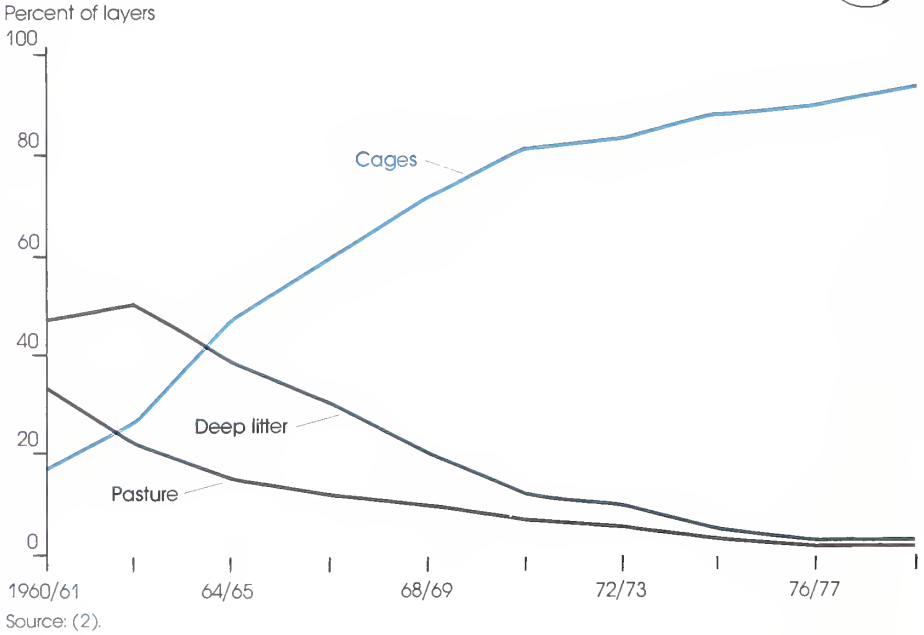
EC Layer Welfare Laws

The Council of Ministers of the European Community (EC) in 1986 established space and other requirements for caged layers. These requirements applied to all newly built or newly used cages starting January 1, 1988, and will apply to all cages as of January 1, 1995 (*3*):

- At least 450 square centimeters of space per bird;
- 10 centimeters of feed trough space per bird;
- A continuous drinking channel or two nipple drinkers or cup drinkers per cage;
- 40 centimeters of height over 65 percent of the cage area and not less than 35 centimeters at any point; and
- Floors with slopes not exceeding 14 percent (steeper slopes are permissible if the floor is not rectangular wire mesh).

However, some West European countries in and outside of the EC have different standards. Switzerland will ban cages after December 31, 1991, reversing a 50-year-old innovation for confinement egg production (*4*). Cages may also be banned in Sweden and the Netherlands (*5*). Sweden and Denmark require that birds have 600 square centimeters of cage space (*4, 5*). UK legislation requires that by 1995 four-bird cages have 450 square centimeters per bird, three-bird cages 550 square centimeters, and single-bird cages 1,000 square centimeters (*4*).

FIGURE 1 **Most UK Layers Are Caged**



Source: (2).

Table 1—The index of inputs rises while output falls for selected alternative options to cages

	Labor	Feed	Eggs
	Birds/person	*Kg/hen*	*Number per hen/year*
Cages	100	100	100
Deep litter	80	99	96
Pasture	18	107	85

Source: (7).

Alternatives to Cages

Without cages, production costs rise because of more labor and feed requirements. Eggs laid decline (table 1 and fig. 2).

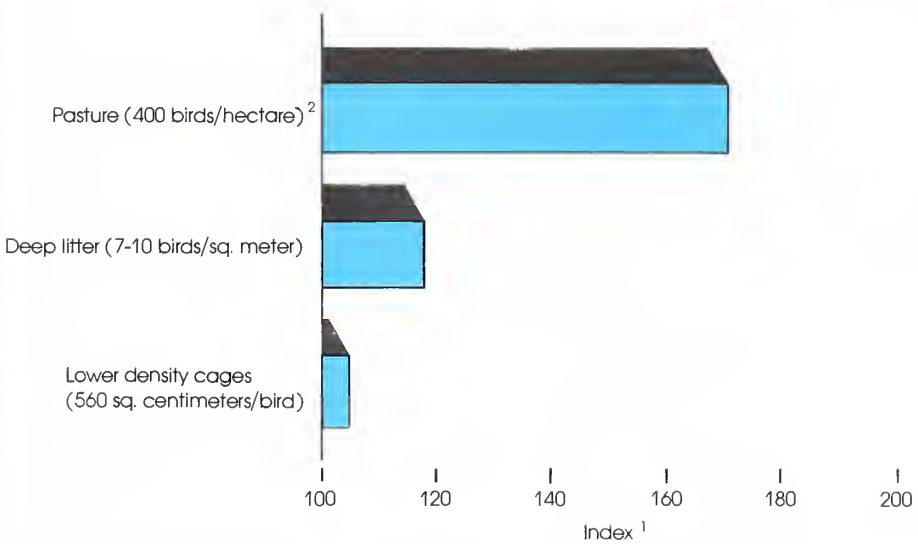
With the deep litter system, layers are free to move about in their building, but cannot go outside. The lower stocking density makes it uneconomical to maintain the optimum building temperature for feed conversion during the winter, so feed consumption will be higher than with cages.

The pasture (or free-range) system allows layers to go outside their building. This system can be operated in many ways. At one extreme, small portable houses for the birds are moved regularly to clean ground to prevent disease buildup. Feed consumption will be high because the houses will be cold in the winter. More labor is needed to move feed to each house and collect the eggs. Egg yield per bird falls. At the other extreme, large stationary houses with automatic feeding and environmental control are used. Because these buildings are not moved, however, there are disease build-up problems on the pastureland.

Cost per egg rises as housing intensity declines and the layers are exposed to more weather hazards, disease problems, and predators, if outside.

While there may be free trade among EC countries by 1992, higher legislated production standards in some countries put affected producers at a cost-of-production disadvantage. *[Gary Vocke (202) 219-0718]*

FIGURE 2 **Less Intensive Egg Production Costs More**



1 Costs for birds raised in cages according to EC minimum standard (450 square centimeters per bird) = 100. 2 Includes land rental.
Source: Adapted from (1).

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The Expanding Role of Environmental Interests in Agricultural Policy

by
Katherine H. Reichelderfer*

Agriculture in the present day is associated with depletion of underground water sources, degradation of soil resources, contamination of surface and ground water with substances that run off or percolate from agricultural land, destruction of wildlife habitat, and endangerment to biodiversity. 1/ A recent survey by an Iowa firm cited by *The Wall Street Journal* found that 86 percent of farmers feel townspeople see them as polluters. The perception would certainly not be greatly different in European countries where fertilizer application rates are several times higher than in the United States, or in many other developed countries, for that matter.

Agriculture is really no different from other industries in that it generates waste materials. But unlike other sectors of the economy—in which pollution has increasingly been controlled through Federal standards, fees and fines, restrictions, or (more recently) market-based incentives—agriculture is unique in having engendered relatively less Federal Government intervention with respect to its environmental consequences. When intervention has occurred, it has been achieved—more often than in other industries—through mechanisms that increase rather than decrease producers' incomes.

Federal agricultural resource and environmental programs have existed in the United States since the 1930's. As originally established and traditionally maintained, these programs have been largely voluntary and have relied on positive incentives to achieve their goals. For instance, agricultural landowners have long had access to the Agricultural Conservation Program, the Soil Conservation Service, and the Great Plains Conservation program, which, along with similar programs, offer technical and financial assistance for voluntary initiation of soil and water conservation planning and implementation at the farm level. The current Conservation Reserve Program—like its predecessor, the Soil Bank Program of 1956—allows farmers to receive annual rental payments from the Federal Government for retiring land on which cultivation may pose environmental hazards. Such programs mutually benefit the environment and the farmers who choose to participate in them.

Only since 1985 have some penalties been added to the incentives offered to farmers for resource conservation. (See the article in this issue by Tobey.) While involving penalties of a sort, these compliance programs are also voluntary. Any participant in a farm program is free to drop out rather than comply with its environmental requirements. As conditions in agricultural markets improve (making farm program safety nets less necessary) or the level of farm program benefits declines, the penalty for noncompliance with environmental guidelines can rapidly diminish.

Agriculture has thus far been overlooked by or excused from meeting the requirements of most environmental policies that apply to other sectors of the economy. Federal policy regarding water quality and toxic substances had focused on point sources of pollution, postponing the more difficult problem of nonpoint sources, mainly agricultural. For instance, the Clean Air and Water Quality acts impose technology-based standards that affect the location, configuration, operating conditions, and costs of virtually all industrial and public utility facilities, yet they place no limits on effluents or emissions from agricultural and other nonpoint sources of air and water pollution. Similarly, industries and municipalities spend an estimated $23 billion to $30 billion annually to comply with the 1972 Federal Water Protection Control Act, yet that act authorizes Federal subsidies to help States plan and farmers adopt water quality management strategies for which there are no associated standards.

The unique treatment of agriculture is apparent in a range of resource conservation and environmental policies. During the energy crisis of the 1970's, agriculture was routinely exempted from controls on the price and availability of fuels. At present, agricultural landowners whose practices have rendered land unusable (through accumulation of salts, heavy metals, or other toxic substances it the soil) are not subject to any law equivalent to that which requires land users to return areas scarred by surface mining to their original condition at private cost. Thus, while the centralized or command-and-control approach to environmental policy had been given precedence in nonagricultural sectors, incentive-based and subsidy approaches have predominated in the agricultural sector, Why is this so?

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1/ The variety of plant and animal species.

Is Agriculture Special?

In some respects, unique approaches to minimizing potential environmental damages from farming might seem warranted. First, there is more uncertainty about the nature of nonpoint sources of pollution than there is about readily observable point sources. Contaminants from nonpoint sources cannot easily be traced either to agricultural activities (some could originate naturally or in a golf course or home garden) or to a specific parcel of land or land operator. Thus regulations based on limitations on or requirements for certain agricultural practices—with or without associated fees, fines, or taxes—are more difficult to design than are regulations for point sources of pollution, which can be monitored. (An important exception is the waste disposal problem in the intensive livestock sector discussed in this issue by Vocke.)

Second, in farming, individuals are making use of privately owned resources. In other industries, where environmental concerns focus on the private use of public goods such as air and water for discharge, there are few counterparts to the property rights issues involved in decisions about how farmers use their own land. Questions about whether farmers' property rights might be violated by environmental regulation that acts upon the public's right to an undegraded environment are also complicated by a favorable public attitude toward American farmers. The special reverence with which small farms and family farms are regarded is not common to most other groups of producers, especially in the manufacturing sector, and creates a public desire to resolve environmental problems without hurting farmers.

Finally, agriculture in the United States and other developed countries benefits from a network of farm income and price support programs. These programs weaken proposals for legislating incentives for environmentally beneficial changes in agricultural practices.

The fact that policy options for more efficient control of agricultural sources of pollution have not been implemented more frequently suggests that there are other factors influencing the direction that agroenvironmental policy 2/ has taken to date. Research at Resources for the Future shows that it is largely broader political and economic trends that have most influenced past patterns and that are likely to change future policy approaches to environmental regulation in American agriculture.

Critical Factors

Trends in the value of gains and losses as perceived by public interests on the one hand and agricultural interests on the other, and the subsequent influence of competing interests on the policy process, best explain policy choices for environmental regulation of agriculture. How the public and its representa-tives view and value the goods arising from agricultural activities depends on many factors, one of which is economic growth.

Rising per capita income in the developed economies increases the level of demand for goods such as environmental quality, recreation, and aesthetics at a greater rate than it does the level of demand for basic goods like food and fiber. Demographics reinforce this demand as an aging population with greater leisure time exerts pressure for clean recreational and retirement sites. Concomitant with these trends is a generally increasing valuation by the public of the environmental costs arising from agricultural production. As perceived costs rise, the proclivity to protect agriculture may decline in relation to the demand for environmental regulation of agriculture.

At the same time, the relative size of the agricultural sectors of developed economies tends to decrease as the economy continues to grow. The decline in the number of farmers associated with the more advanced agricultural economies actually increases rather than decreases the political influence of agricultural interests. As the size of the agricultural community decreases, each member of that community has a larger personal stake in decisions about agroenvironmental policy.

The response of legislators to these oftentimes competing interests is in part a function of how well farmers are faring in relation to the rest of the economy. There seems to be a strong correlation between relative farm income and the passage of agro-environmental legislation, as well as the form that legislation takes. When farmers are perceived as being richer than the rest of us, it is more likely that restrictive legislation will be passed. The Safe Drinking Water Act was passed in 1974, when farm income was high. Conversely, when farmers are suffering financially in relation to the rest of the economy, legislation addressing agroenvironmental problems has tended to take the form of a subsidy that enhances farm income. For example, the Conservation Reserve Program was written into the 1985 farm bill just as farm income was beginning to recover from the crisis of the early 1980's.

The political strength of environmental interest groups lobbying to represent public interests in agroenvironmental quality is also an important factor. The number of environmental groups involved in agricultural policy, their membership, and the resources available to them have grown dramatically over the last two decades. As environmental groups become increasingly efficient at exerting pressure, the degree to which environmental interests influence policymaking may rise. Independent of the activities of these groups, the public's demand for environmental regulation of agriculture will be determined by the extent of evidence about levels and possible consequences of environmental contaminants from agricultural sources.

2/ Agricultural policy that affects the environment, and environmental policy that affects agriculture.

Implications for the Future

Many of the factors that have affected the levels and direction of U.S. agroenvironmental policies in the past are still in evidence or are gaining in influence today. The long-term outlook for the economy is continued growth, implying a continued general shift of public preference toward environmental regulation of agriculture. Farm income has recovered from the crisis of the early 1980's, reinforcing trends that place greater weight on environmental interests in policymaking. Furthermore, the size and influence of environmental and other public interest groups concerned with agroenvironmental policy are growing.

Other factors may produce more Federal regulation of agriculture for the purpose of environmental protection. One is the changing composition of the House of Representatives, which with each redistricting in recent years has lost some proportion of representation from rural and farming-dependent regions. Others include increasing agricultural productivity, shifts in agricultural trade patterns, and the proliferation of environmental regulation at the State level which raises for the first time the issue of uniform scientific standards.

U.S. agricultural productivity increased an average of 2 percent per year during the 1980's. As the efficiency of production continues to increase, the costs to the public of agricultural programs will rise (unless demand increases at the same rate—a phenomenon not expected in the short run—or reserves committed to agriculture are reduced or used less intensively). These rising costs could threaten the political support for agricultural programs in the face of rising resistance by taxpayers, implying a future decrease in agricultural protection relative to environmental protection.

As for trade, some observers have suggested that in the context of the Uruguay Round of multilateral negotiations under the General Agreement on Tariffs and Trade (GATT), reduced distorting subsidies to agricultural producers could be partially offset by agricultural assistance programs that are oriented toward environmental protection or conservation. (The situation in Australian agriculture is discussed in this issue by Hyberg and Pascoe.)

Regardless of the outcome of GATT negotiations, continued or increased reliance by U.S. agricultural producers on the export market will reinforce pressure for reforms in the agricultural sector. This is because the costs to the public of agricultural support tend to be greater in the relatively price-sensitive export-oriented

National Income Accounting and the Environment

National accounting systems currently in use do not adequately capture the value of natural resources. The gross domestic product (GDP) is mainly a measure of market activity. As the principal indicator of the performance of a country's economy, GDP (or GNP) accounts only for depreciation of man-made capital, and disregards the depreciation of its natural capital. Taking this last factor into account would likely result in a lower value for the country's aggregate output.

When national income accounting procedures were established about a half century ago, the importance of natural capital was overlooked by limiting the concept of "true" income to output derived from man-made capital. Stores of natural wealth currently linked to economic activity include a nation's stock of water, soil, air, and nonrenewable resources. Accounting for the depletion of petroleum, minerals, and forest is widely practiced, but other resources are usually neglected. The United States' environmental and resource accounting has so far been limited to pollution abatement expenditures. Cost-benefit considerations have discouraged accounting for the degradation of natural resources.

The challenge comes from the difficulty of valuing environmental assets and the flow of services from them. While productivity losses from soil erosion, for example, may be measured with relative ease, valuing a species lost through clearing tropical rain forest for cultivation is much more problematical. The obvious measurement difficulties, however, should not lead us to treat natural resources differently from other economic goods and services used in production when it comes to national income accounting.

One proposal for estimating resource-related costs is the user cost approach. By this method, the revenue from the sale of a depletable resource (net of extraction cost) is divided into a capital cost and value-added income. The capital cost is regarded as asset erosion and is therefore excluded from GDP. The larger the current annual exploitation of the resource is in comparison with the known reserves, the larger the capital cost, and thus the smaller the value-added income. Capital cost estimates also depend on the choice of discount rate in the formula and the estimated size of the proven reserves. *[Alberto Jerardo (202) 219-0717]*

commodities, and because the direct and indirect costs of environmental degradation associated with production are not passed on to foreign consumers.

Finally, the number of environmental standards established, laws enacted, and programs implemented at the State level increased dramatically during the 1980's. This increase was partly in response to Federal mandates for States to develop customized environmental protection efforts, and partly a result of public clamor and responsive legislatures in some States. At present, a sizeable proportion of State environmental legislation specifically targets or has direct implications for agriculture.

Great variation in the environmental laws of individual States can create problems for agricultural industries that operate nationally. If and when such variation becomes a serious constraint, the agribusiness industry itself may exert pressure for Federal provision of some uniformity—a pressure that suggests the possibility of increased centralization of agroenvironmental policy in the future.

As the U.S. economy grows, new information on the environmental effects of agriculture is made available, and existing environ-mental legislation is applied to nonpoint pollution sources, the level of environmentally motivated government intervention in agriculture could begin to approach that in other industries. This is not likely to happen overnight or in a continuous fashion. Just as a generally growing economy experiences periodic recessions and expansions, the influence of economic factors on environmental regulation of agriculture is likely to wax and wane.

The form that new legislation takes could depend on the unique characteristics of agriculture, the public's view of agriculture, and the influence of private interests. However, recent trends suggest the increasing possibility that the agricultural sectors of developed countries will be subject to more centralized environmental regulation. Moreover, Federal budget deficit problems in the United States will make it increasingly difficult to address agroenvironmental problems chiefly through subsidy programs, as has been typical in the past.

The choice that farmers, agribusiness, and policymakers face is whether to increase environmental regulation of agriculture through a command-and-control approach or a market-based one. Experience in other industries suggests that the more efficient market-based approach has greater potential for creating a climate under which production that is sensitive to environmental protection is also good for agricultural business.

Agricultural Trade Implications of Environmental Management

by
James A. Tobey*

Abstract: *In principle, countries that introduce costly environmental regulations should experience a reduction in their international trade competitiveness in polluting commodities. Countries that fail to enact environmental protection regulations, on the other hand, presumably increase their export market share in the production of crops that damage the environment. An investigation of some of the issues involved in the determination of potential agricultural trade effects suggests that they may, in practice, be quite modest.*

Keywords: *Trade patterns, environmental management, comparative advantage, competitiveness, pollution intensity.*

Environmental management restrictions on the use of certain agricultural chemicals or practices are unlikely to have noticeable effects on international trade. Early concerns had been that those countries imposing such restrictions, such as the United States, would be at an economic trade disadvantage to those with freedom to operate without restrictions.

However, research so far indicates little support for worries about trade-distorting effects, no matter how plausible they seem. Estimates of the economic and trade impacts of environmental controls in agriculture are limited because these programs have been modest, and many of them are relatively new.

In the United States, Federal legislation regulating pollution sources in agriculture include the 1972 Pesticide Control Act and the 1987 Water Quality Act. Environmental considerations also entered into the 1985 Food Security Act and the Food, Agriculture, Conservation, and Trade Act of 1990. Soil conservation and natural habitat protection programs introduced in 1985 include the Swampbuster, Sodbuster, and Conservation Compliance provisions, and the Conservation Reserve Program (CRP) (see box).

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Impact of the CRP

With the CRP and other compliance programs, the United States probably has more ambitious soil conservation programs in place than other industrialized countries. However, a comparison of other environmental programs suggests roughly similar degrees of effort (*11*). Like the United States, nearly all other industrialized countries require extensive testing and evaluation of new pesticide products before they can be licensed for sale; they also have food safety standards related to chemical residues; and they all have research and extension programs that, in many cases, encourage the use of more environmentally benign production practices. Some countries have also introduced modest fees and restrictions on pesticide and fertilizer use.

Since nearly all industrialized countries have introduced environmental measures toward agriculture—and at roughly the same time—it is likely that the structure of relative costs among this group of countries remains largely unchanged. These countries also hold a large share of total world agricultural exports (developed market economies accounted for 84 percent of 1988 world cereal exports) (*4*). In contrast, less developed countries (LDC's) with lower per capita income have reacted more slowly to environmental problems associated with agricultural production. The demand for environmental quality is understandably low in these countries; other serious problems associated with low levels of income are more pressing (*14*).

If the differentials in the costs of complying with environmental regulations toward agriculture in industrialized countries and LDC's are sufficiently large, LDC's may tend to develop a comparative advantage in the production of "pollution-intensive" agricultural commmodities and gain market share. This effect will depend, in part, on LDC supply flexibility in response to small changes in international markets. However, LDC responsiveness to changes in international market signals is likely to be limited because capital markets function poorly in LDC's, and their agricultural sectors are typically taxed.

The magnitude of changes in the patterns of world agricultural trade also depends on the share of LDC's in the world trade of commodities that are most affected by policies to protect the environment. The potential loss in U.S. export markets resulting from costly pollution controls will be greatest when LDC's account for a large share of foreign competition.

Major Finding

Some small reduction in U.S. trade competitiveness in agriculture can be anticipated with the introduction of more stringent environmental control policies. However, the actual magnitude of trade losses is likely to be small.

Resource and environmental programs affecting U.S. agriculture

Legislation	Key Provisions	Comments
Land use		
Swampbuster provision	Denies government program supports to any person producing an agricultural commodity on wetland converted since December 23, 1985.	Reduces incentives to convert wetlands to farmland. There are 60 million acres of wetlands in private ownership. Between 5 and 16 million acres may be convertible.
Sodbuster provision	Denies government program supports to any person producing an agricultural commodity on highly erodible land converted since December 23, 1985, unless an approved conservation plan is adopted and implemented.	Affects 227 million acres with some potential for conversion. Erosion on sodbusted land must be reduced to the soil tolerance level (T), which averages 5 tons of erosion per acre per year.
Conservation compliance provision	Requires farmers with highly erodible cropland to begin implementation of a conservation plan by 1990 and complete it by 1995 to retain eligibility for government programs.	Could affect production costs on up to 65 million acres depending upon the level of enrollment in CRP and the level of treatment required.
Conservation Reserve Program	Pays farmers annual rental payments and half the cost of establishing permanent cover for retiring highly erodible cropland for 10 years.	Over 100 million acres are eligible for enrollment in program. Current enrollment is 33 million acres.
Water Quality		
1987 Water Quality Act	Requires each State to identify navigable waters which cannot regain or maintain applicable water quality standards without reducing NPSP. Instructs States to identify categories of NPSP contributo pollution of degraded waterways, and to identify best management practices to reduce NPSP to maximum practical extent and to improve quality of these waterways.	Farmers whose practices are judged to contribute to nonpoint source water pollution problems could be subject to state or local restrictions on land use and agricultural chemical use. Impact on farmers will vary by state.
Pesticides		
1972 Pesticide Control Act	Under this Act, the EPA is responsible for regulating all pesticides produced, which includes both registration and use. The EPA is also authorized to suspend, cancel, or restrict uses of pesticides that present "unreasonable" risk to man or the environment.	The complexity and ambiguity of the Act have made it difficult to implement. The Federal Pesticide Act of 1978 and the 1986 amendments to the Federal nsecticide, Fungicide, and Rodenticide Act have centered on accelerating the reregistration process. Only a few pesticides (DDT, aldrin, and dieldrin) have been banned to date.

Note: NPSP = Non-point source of pollution.

In only 5 of the 10 crops studied (tobacco, cotton, peanuts, rice, and sorghum) do developing countries hold a greater than 20-percent market share of foreign competition. Furthermore, only three of these five (tobacco, peanuts, and sorghum) are "above average" in terms of "pollution intensity" (see box).

If it is assumed that the most stringent environmental regulations attempt to target crops that are the most "pollution intensive," then any significant displacements of industrialized country agricultural exports attributable to pollution controls would most likely occur in these three crops. However, sorghum, tobacco, and peanuts represent only a small portion of total world agricultural trade (less than 1 percent); thus, their impact on agricultural trade patterns overall is likely to be small. In the case of the United States, total agricultural exports were about $31 billion in 1987, with exports of sorghum, peanuts, and tobacco accounting for only $1.7 billion (*4*).

The trade effects of environmental controls on industry are difficult to uncover (*9, 13*). Studies have been unable to show that industrial pollution control measures have resulted in a loss of export markets or in increased imports of products of polluting industries. The primary reason seems to be that the costs of pollution control have not, in fact, loomed very large even in the most polluting industries (*11*). Further, the small increases in industrial production costs are likely to be swamped in their impact on international trade by the much larger effects of differentials in labor costs, or swings in exchange rates, for example.

The trade effects of pollution control toward agriculture will probably also be swamped by these effects, as well as by other changes, such as variations in foreign demand for agricultural commodities, and domestic changes in agricultural commodity policy. Given the unusually high degree of government intervention in agricultural markets across the world, the latter may make it particularly difficult to discern the impacts of environmental policy on agricultural trade.

In short, based on the record of experience with industrial pollution controls and the circumstances in which agricultural trade takes place, it is unlikely that domestic environmental policies directed toward agriculture will have noticeable effects on patterns of international trade. Nor are such policies likely to seriously damage U.S. competitiveness in international agricultural markets.

Table 1—Ranking of crops by nitrogen use, 1987

Crop and ranking	Unweighted nitrogen use	Nitrogen use weighted by leaching vulnerability
	Pounds/acre	
1. Tobacco	164	1/
2. Rice	131	49
3. Peanuts	83	46
4. Corn	122	40
5. Cotton	73	27
6. Sorghum	72	22
7. Wheat	61	20
8. Barley	44	14
9. Oats	23	7
9. Soybeans	19	7

1/ The vulnerability index was not applied to tobacco because regional production data were not available.
Sources: (15) and (16). Tobacco nitrogen information is from (3) and (7).

Table 2—Ranking of crops by pesticide use weighted by leaching vulnerability

1. Peanuts
2. Sorghum
3. Corn
4. Tobacco
5. Soybeans
6. Cotton
7. Wheat
8. Rice
9. Oats
10. Barley

Sources: (5), (6), and (8).

Table 3—Ranking of crops by erosiveness

Crop and ranking	Erosiveness
	Metric tons of erosion/acre
1. Tobacco	12.0
2. Soybeans	7.1
3. Corn	6.6
4. Peanuts	6.4
5. Sorghum	4.4
6. Oats	4.2
7. Cotton	3.7
8. Wheat	3.2
9. Barley	2.8
10. Rice	0.2

Source: (17).

Ranking Crops by "Pollution Intensity"

The impact of environmental regulatory costs on agricultural trade requires some means of ranking the commodities involved according to their "pollution intensity," that is, identifying the ones that are likely to cause problems.

Ten major U.S. crops were studied based on their average per-acre use of nitrogen fertilizer and pesticide, and soil erosion.

The rankings by nitrogen and pesticide use also account for the potential of these chemicals to accumulate in water. This is important because, ideally, environmental regulations target crop production systems that generate large environmental damages, rather than systems that use large amounts of chemicals. Accumulations depend on climate, soil type, topography, depth to ground water, and other hydrogeologic properties.

On a per-acre basis, the crops that are most "pollution intensive" are tobacco, peanuts, corn, sorghum, soybeans, and cotton, reflecting the fact that row crops require more chemical inputs and are also more soil erosive. Rice, wheat, oats, and barley were determined to be less "pollution intensive." This overall ranking very likely applies to other countries as well as the United States.

Table 4 also shows the market shares of the 10 crops for the LDC's. Even large increases in LDC comparative advantage would probably not translate into large deviations in industrialized country agricultural trade.

A more technical explanation of how "pollution intensity" was determined is available from ERS economist James A. Tobey (202) 219-0403, or by writing to ERS, 1301 New York Avenue, N.W., Washington, DC 20005-4788.

Table 4—Ranking of crops by "pollution intensity"

Crop and ranking	Summation of rankings of indexes for nitrogen, pesticides, and sedimentation	LDC market share (1985-87)
		Percent
1. Tobacco	6	42.2
2. Peanuts	8	26.1
3. Corn	10	12.6
4. Sorghum	13	23.9
5. Soybeans	16	19.2
6. Cotton	18	39.5
7. Rice	20	26.1
8. Wheat	22	6.2
9. Oats	24	4.4
10. Barley	27	1.1

"Pollution Intensity" and Trade Performance of 10 U.S. Crops

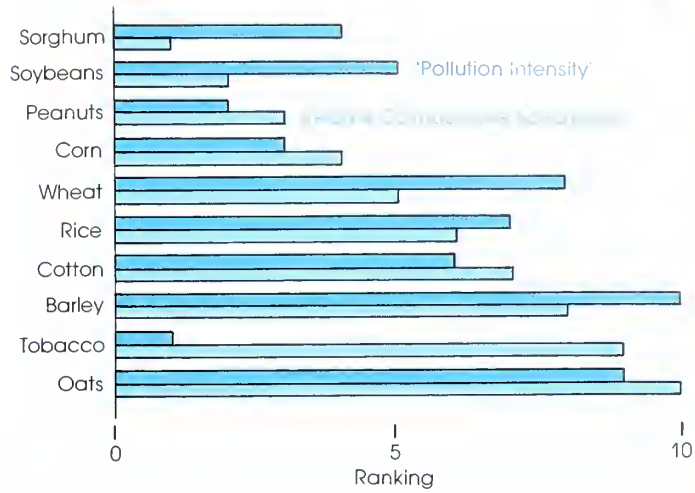

Table 5—Comparison of RCA and "pollution intensity" rankings in the United States

Crop	1985-87 RCA	RCA ranking	"Pollution intensity" ranking
Sorghum	73877	1	4
Soybeans	3897	2	5
Peanuts	467	3	2
Corn	432	4	3
Wheat	177	5	8
Rice	154	6	7
Cotton	57	7	6
Barley	17	8	10
Tobacco	4.7	9	1
Oats	.07	10	9

Revealed Comparative Advantage

A frequently used measure of trade performance is the "revealed comparative advantage" (RCA) index (*2*). The RCA index is a better measure of competitiveness than a simple comparison of historical market shares because it is not sensitive to changing global economic conditions. The RCA index, as used here, compares the U.S. ratio of the share of exports to imports of a particular crop with the ratio of the share for the rest of the world. The RCA index does not indicate why a particular country performs well or badly in a specific commodity, it simply reveals the historical record of trade performance. High RCA index values indicate that a country is an above-average net exporter.

Fertilizer Intensity of U.S. Agricultural Exports

Recently, researchers have used input-output models to calculate the factor intensity of a country's agricultural trade. The factor intensity of agricultural exports is defined as the total amount of a factor required economywide to produce a representative $1 million worth of exports. This is a useful measure for showing trends because it reflects instantaneously the combined effects of changes over time in relative prices of the commodities a country exports, in the commodity composition of a country's exports, and in the productivity of the factors used to produce those commodities for export. We have followed this method in order to calculate changes in the fertilizer intensity of U.S. agricultural exports over the period 1977-87.

We explored this question using data from 1977 and 1987, the most recently available with the required level of detail. We found that in 1977, U.S. farmers used 2.1 million nutrient tons of nitrogen, 1.3 million nutrient tons of phosphates, and 1.3 million nutrient tons of potash to produce the total of $23.6 billion worth of agricultural commodities exported in that year (table 1). This made for fertilizer intensities of 90 tons, 54 tons, and 52 tons, respectively, or 196 tons overall. Similar calculations for 1987, adjusting for inflation, showed ferti-lizer intensities of 86 tons for nitrogen, 40 tons for phos-phates, and 41 tons for potash, or 167 tons overall (table 2).

These lower per-unit nitrogen, phosphate, and potash fertilizer needs for higher levels of exports reflect several trends. The total amounts of these fertilizers used for all farm production were lower in 1987 than in 1977 (8.7, 4.0, and 4.4 million nutrient tons, respectively, compared with 9.3, 5.3, and 5.4 million). However, the percentages of nitrogen, phosphates, and potash inputs in the U.S. agricultural sector that were used for producing exports were 27, 27, and 26, respectively, in 1987, up from 22, 24, and 22 in 1977. Thus, even though the shares of these fertilizers used for exports in 1987 were higher than in 1977, because the level of exports of fertilizer-intensive commodities such as foodgrains, feedgrains, oil crops, and cotton had risen during that period, the fertilizer intensity of U.S. agricultural exports over all decreased.

Our estimates also show that fertilizer use per unit of output in U.S. agriculture, in general, declined from 1977 to 1987. For example, in 1977, 229 nutrient tons of nitrogen were used per $1 million of feedgrain output, which declined to 187 nutrient tons in 1987. Food and feed grains show the highest fertilizer use per unit of output in both 1977 and 1987.

Fertilizer usage in agricultural exports is a derived and indirect demand. Using an input-output model for the analysis enabled us to identify "direct and indirect" fertilizer demand. For example, the 2.4 million nutrient tons of nitrogen used to produce and export $27.9 billion (in constant 1977 prices) of agricultural commodities in 1987 includes several levels of demand. It includes the direct demand of 1.7 million nutrient tons of nitrogen by food and feed grains. It also includes 113,000 nutrient tons of indirect demand by the processed meat products sector (fertilizer to grow the feed for the meat animals providing the inputs for processed meat products).

Summing up, our analysis reveals several findings about U.S. agriculture. First, the fertilizer intensity (fertilizer use per unit of crop output) declined over the 1977-87 period. Second, while overall fertilizer usage declined, our major agricultural export commodities are more fertilizer-intensive than most other commodities within the agricultural sector. Finally, export demand does increase the fertilizer intensity of U.S. farm production, but this intensity has been falling.

For further information, see Darryl S. Wills and Chinkook Lee, *Factor Intensity of U.S. Agricultural Trade*, AER-637, U.S. Department of Agriculture, Economic Research Service, Washington, DC, August 1990. *[Chinkook Lee and Gerald Schluter (202) 219-0785]*

Table 1—Fertilizer intensity of U.S. agricultural exports, 1977

Agricultural exports and value		Fertilizer nutrients used			
		Nitrogen	Phosphates	Potash	Total
	Million dollars	*1,000 nutrient tons*			
Livestock	209.5	15.6	8.9	9.3	33.8
Food grains	2,732.2	598.0	296.1	151.7	1045.8
Feed grains	4,912.5	959.7	535.2	565.6	2060.5
Cotton	1,534.8	135.8	61.0	38.0	234.8
Vegetables, fruits and nuts	975.6	101.3	29.6	57.6	188.5
Oil crops	4,791.9	47.0	158.6	216.5	422.1
Tobacco	1,094.2	9.4	10.4	16.6	36.4
Meat Products	1,514.6	86.6	49.2	51.7	187.5
Feeds and flours	1,560.2	100.5	53.1	40.9	194.5
Vegetable fats and oils	2,334.1	37.4	48.6	59.8	145.8
Other processed food	1,407.3	26.7	15.2	15.4	57.3
Other agricultural products	569.1	19.2	6.3	5.4	30.9
Total	23,636.1	2,137.2	1,272.2	1,228.5	4,637.9
Fertilizer intensity of ag. exports (tons)		90	54	52	196

Table 2—Fertilizer intensity of U.S. agricultural exports, 1987

Agricultural exports and value		Fertilizer nutrients used			
		Nitrogen	Phosphates	Potash	Total
	Million 1977 dollars	*1,000 nutrient tons*			
Livestock	357.2	23.0	11.1	12.5	46.6
Food grains	3,593.7	934.1	334.4	148.5	1,417.0
Feed grains	5,082.6	814.0	392.1	443.4	1,649.5
Cotton	1,988.5	130.5	44.2	33.0	207.7
Vegetable, fruits, and nuts	1,157.5	127.0	26.5	62.3	215.8
Oil crops	6,047.1	44.3	147.2	260.7	452.2
Tobacco	391.8	9.8	8.1	15.4	33.3
Meat products	2,378.7	112.9	54.9	62.1	229.9
Feeds and flours	1,910.2	115.3	44.6	31.1	191.0
Vegetable fats and oils	2,272.9	29.8	33.3	53.3	116.4
Other processed foods	1,863.0	28.6	13.1	14.5	56.2
Other agricultural products	839.0	41.1	5.5	9.3	55.9
Total	27,882.3	2,410.8	1,115.4	1,146.5	4,671.5
Fertilizer intensity of ag. exports	86	40	41	167	

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Impact of Environmental Safeguards on the Livestock Sector

by
Gary Vocke*

Abstract: *Geographical concentration of high-intensity livestock production has created regions with surplus manure in several West European countries. Manure disposal in these regions sometimes pollutes public water supplies. Reducing livestock concentrations would minimize the risk of pollution, but also lower farm incomes. To reduce the pollution risk while allowing regional concentrations of high-intensity livestock production to continue, governments are experimenting with changes in manure management and cropping practices. This article examines related legislation in three European countries.*

Keywords: *Livestock production, manure management, nitrates, water pollution.*

Livestock production contributes more than half of the total value of agricultural output in many West European countries (table 1). The geographical concentration of livestock operations in some regions is so high that their production of manure exceeds what is environmentally safe to apply on the land. When manure applications (and manufactured fertilizers as well) exceed crop requirements, excess nutrients such as nitrogen may enter public water supplies.

The risk of pollution was much lower before World War II, when farmers' reliance on their own crops to feed livestock limited the number of livestock per unit of production. Animal production changed, however, with the introduction of confinement livestock production technology in the 1960's. This led to larger, more specialized livestock operations that often fed grains grown on other farms, and sometimes in other countries. One indication of the trend to larger operations is the fact that in the European Community (EC) the total number of hogs marketed per farm is increasing for larger operations, but declining for small ones (fig. 1). Because of economies of size, this trend will likely continue. A recent study of modern swine production technology found substantial economies of size up to 10,000 head (the largest considered) (*16*).

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In addition to these trends, total livestock numbers in the EC have increased as production rose to meet rising demand for meat, dairy, egg, and other products. Because this expansion of livestock production has not occurred evenly, large differences now exist between European countries (table 1) and among regions within countries. Regional concentrations of livestock raise the risk of animal waste pollution, especially by nitrogen.

The risk of pollution is high because nitrogen is easily converted to gaseous forms that escape into the atmosphere and are leached from the soil into ground water. Such atmospheric pollution contributes to formation of acid rain. Nitrogen pollution of public water supplies is a health concern because of the risk of stomach cancer and blue baby syndrome (methaemoglobinemia), a respiratory problem. The risk is more theoretical for stomach cancer than it is for blue baby syndrome. Nitrogen in food or water may produce nitrosamines in the stomach, which can cause cancer in animals.

Blue baby syndrome occurs only in babies under 3 months of age. Excess nitrogen can result in a baby's blood taking up nitrogen instead of oxygen, causing respiratory failure. Its occurrence is rare because parents can provide denitrified water during the 3 months the child is at risk. In the United Kingdom (UK), there have been 14 cases in the last 35 years, all associated with well water contaminated with nitrates over 100 parts per million (ppm) (*9*). The last reported case in Britain was in 1972 (*1*).

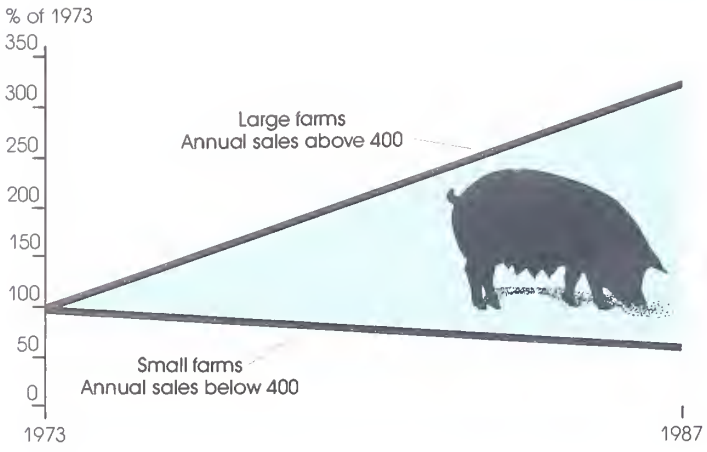
Table 1—Livestock production is more important and more concentrated in the Netherlands than elsewhere in Western Europe

Country	Value of livestock production as percent of total agriculture	Index of concentration of livestock production compared to U.S. 1/
Netherlands	78	18
Belgium-Luxembourg	73	9
West Germany	69	4
Denmark	69	3
United Kingdom	64	3
France	52	2
Italy	37	2
United States	47	1

1/ The index is calculated in two steps. The concentration of livestock production is measured as the total weight of meat and eggs produced per hectare of arable land. Comparison with the United States is made by dividing each country's concentration by U.S. concentration. The result for the United States is 1. The value of 18 for the Netherlands, for example, shows that livestock production per hectare is 18 times more concentrated than in the United States.

Source. (14)

FIGURE 1 **More Pigs Marketed from Large Farms; Fewer from Small Units**



Source: (4).

Nitrogen pollution is also an ecological concern. The loss of nitrogen to the atmosphere while in storage or after spreading on the field contributes to acid rain. Surface water enriched with too much nitrogen has excessive plant and algae growth, which in turn deprives other plants and fish of the oxygen, light, and space they require.

Regional Concentration Leads To Nitrogen Pollution

Severe manure disposal problems occur in a few regions of Western Europe because of high livestock density These regions have public water supplies that cannot meet the EC standard for potable water of 50 mg of nitrate per liter, 50 ppm (*9*). Countries with problem areas include the following:

Netherlands. The southern Netherlands has the highest intensity of livestock production, 2-3 times greater than the national average (*11*). Total manure production in the Netherlands is estimated to be 95 million tons, of which 15 million is surplus where it is produced (*1*). This very high intensity results in more manure than can be applied to the land without risks of nitrate leaching. Ammonia released from manure is also a problem. Recently, 70 percent of the country's nitrogen-related acid rain was attributed to agriculture (*1*).

Belgium. Belgium's situation is similar to that of the Netherlands. Total manure production is estimated to be 41 million tons, of which 8 million is surplus (*1*).

Germany. In the western part of Germany, Lower Saxony has nitrogen pollution problems because the region has a high density of livestock farms. The concentration of livestock production in specialized units was encouraged in East Germany as a matter of policy, leading to problems yet to be resolved.

Denmark. Many of Denmark's lakes and marine waters have unacceptably high levels of nitrogen and phosphorus. Agriculture has been held responsible for most of the nitrate pollution, while phosphorus pollution is mostly attributed to urban waste water. Uncontrolled spreading of pig manure causes most of the agricultural pollution (*9*).

United Kingdom. In the UK, a few watersheds have high concentrations of nitrates in public water supplies. For 1987-89, the agricultural pollution sources were: slurry manure (28 percent), silage effluent (25 percent), and dirty water (19 percent) (*14*).

France. One province of France, Brittany, has 40 percent of the country's intensive livestock operations. This region supplies half of France's pig production and one-third of poultry production. Brittany is also France's leading dairy region. This concentration of livestock production has led to water pollution problems in recent years. In the early 1980's, public water supplies in only one region of Brittany showed nitrate levels above the EC standard. Now there are 5 more regions exceeding the EC standard of 50 mg of nitrate per liter, and 21 others above 40 mg (*11*).

Figure 2

How To Provide the Public With Low-Nitrate Water

Prevent nitrate pollution by:

- Improving manure storage
- Limiting manure applications
- Incorporating manure in soil
- Not applying manure in fall
- Growing fall crops
- Transporting manure elsewhere
- Limiting use of manufactured fertilizers
- Reducing concentrations of livestock

Reduce nitrate concerntration in already-polluted water by:

- Blending with low-nitrate water
- Chemically treating to remove nitrates

Table 2—Average optimum nitrogen application for different crops in long-term field trials

Crop	Clay soil	Sandy soil
	Kg N/ha	
Potatoes	215	190
Sugarbeet	130	170
Wheat	125	170
Barley/oats/rye	90	105
Silage corn	200	150

Source: (6).

Table 3—Number of livestock units producing manure equivalent to one mature cow

Nutrient	Cattle	Pigs	Laying hens	Broilers
		Units		
Nitrogen	1	8	176	546
Phosphorus	1	5	53	272
Potassium	1	16	278	893

Notes: 1. Kilograms of nutrients from one cow, annually: nitrogen, 89; phosphorus, 18; potassium, 85. 2. Per pig unit, 2.2 animals raised per year. 3. One hen per year. 4. Per broiler unit, 5.5 broilers raised per year.
Source: (6).

Italy. The Po Valley in Italy has a nitrate pollution problem because of the concentration of intensive livestock production.

Clean-up Versus Prevention: The Options

There are many options to provide low-nitrate water (fig. 2), each having a different cost, and different people bearing the cost. This section presents policy alternatives to reducing livestock production.

Reduce nitrogen concentration after pollution. The options to reduce nitrate concentration of polluted water include blending of high- and low-nitrate water and/or chemical treatment. Blending is usually the cheapest way of reducing nitrate concentrations in polluted water. Chemical denitrification is more expensive.

Prevent nitrogen pollution. The options to limit nitrogen pollution following manure disposal include: limiting the quantity of manure applied on the land, immediately incorporating the manure into the soil, applying the manure only in the spring and summer, and growing fall crops. There is also the possibility of limiting use of manufactured fertilizer.

Optimum nutrient requirements for major crops are well known. Excessive application of manure and manufactured fertilizers (table 2) is subject to leaching. Land disposal of manure adds considerable nitrogen to the land (table 3), since most of the nutrients in feed go to manure. For example, about 70 percent of the nitrogen in the feed consumed by dairy cows, swine, and layers is excreted (*2*). Broilers are more efficient: only about half of the nitrogen in their feed ends up in manure.

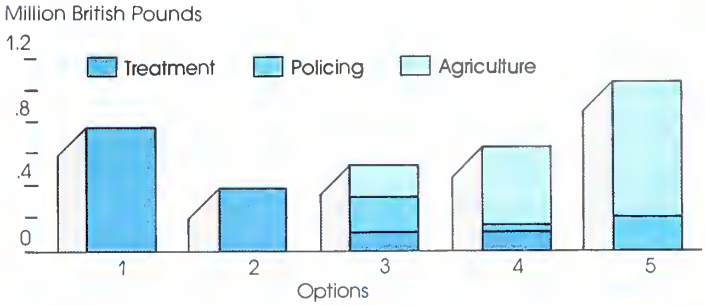
The method of land disposal of manure is important. Immediate incorporation of manure into the soil reduces the risk of surface-water runoff into waterways. This is important because the subsequent breakdown of organic material in manure by microorganisms in the waterways requires oxygen. If there is too much organic material, the microorganisms will use up the water's oxygen and fish will die. Immediately incorporating manure into the soil also reduces nitrogen losses to the atmosphere. In one study, nitrogen losses during the first 3 days after spreading were 17 times greater without incorporation than with incorporation (*8*).

Nitrate leaching occurs mainly from fall to spring. Farmers can therefore reduce this seasonal leaching with fall crops. Growing plants take up water and nitrogen, thus reducing leaching. Autumn crops sown in mid-August can take up more than 100 kg of nitrogen per hectare (ha) (*8*). Nitrogen uptake by crops sown in early September is 50-100 kg per ha, while crops sown in mid-September take up only 10-60 kg per ha.

A Watershed Study of the Tradeoffs

The tradeoffs between public and private agricultural costs of using the options (fig. 3) of reducing versus preventing nitrate pollution were evaluated in a feasibility study of a UK watershed with high nitrogen concentration in the water (*10*). For this particular watershed, it was found that the lowest total cost option to provide low-nitrate water for the public is to dilute high-nitrate water with readily available low-nitrate water and to use some

FIGURE 3 **Costs Vary To Control Nitrate in UK Watershed**



Key
Options: 1. Chemicol treatment only. 2. Blending and chemicol treatment. 3. Blending ond ogricultural controls. 4. Blending with criticol croplond converted to forests. 5. Agricultural control only.
Costs: Treatment - public costs to reduce nitrote concentration in woter. Policing - Public costs to police formers to ensure they ore following the controls imposed on ogriculture. Agriculture -Direct costs to formers in odjusting to controls imposed on ogriculture. Source: (10).

chemical treatment (fig. 3), neither cost being borne by the farmers who polluted the water. Thus, they have no financial incentive to reduce pollution. Relying only on chemical treatment to reduce nitrate concentration raises costs (shown to the left of the blending and chemical treatment option in fig. 3).

The lowest total cost option to provide low-nitrate water that places costs on farmers combines some land use control with limits on manure and fertilizer applications. Some blending, however, is still needed to keep total costs down. Although public treatment costs fall compared with relying totally on blending and chemical treatment to reduce nitrate concentrations, this option has public policing costs to ensure farmer compliance. A more costly agricultural-control option converts those croplands most critical to water quality to forests to reduce nitrogen concentration in the water. Some blending is still used. The cost to agriculture rises with this forestry option. Because it is easy to check for trees, public policing costs fall. The watershed study also considered an option controlling agricultural practices to such an extent that blending is not needed to achieve low-nitrate concentration in the public water supply. Total costs are highest with this option.

The level and distribution of public and private costs calculated for this watershed cannot be generalized to every watershed with a nitrate pollution problem because the agriculture will vary, as well as the hydrology of the watershed. In addition, some watersheds may not have the option of blending if low-nitrate water is not readily available.

Legislation in Three Countries To Prevent Nitrogen Pollution

The regional concentrations of livestock production in the UK and Denmark, in contrast to the Netherlands, are typically low enough to allow safe land disposal of manure, if appropriate farming practices are followed. The UK generally uses voluntary guidelines while Denmark has mandatory regulations. Some regions of the Netherlands have such a high livestock density that the manure produced exceeds the recycling capacity of the land.

United Kingdom. In the UK, control of agricultural practices to reduce the risk of water pollution is mostly voluntary. However, UK water protection legislation makes it illegal to discharge polluting matter into water, whether deliberately or accidentally (*5*). And public water authorities regulate the regular discharge of polluting matter, either directly to water or to land where there is a risk of polluting public supplies. UK water authorities consider that recycling manure to land to provide nutrients for crops is not the same as discharging material. Thus, any water pollution that occurs with the spreading of manure on the land is considered deliberate or accidental pollution.

For some time, the UK has had a Code of Good Agricultural Practice for the Protection of Water. This is only a guide for farmers, and infractions will not create criminal or civil liability (*14*). However, failure to comply could be taken into account in any legal proceedings occasioned by deliberate or accidental pollution. The Code states that the spreading of manure should not exceed 250 kg/ha/year of total nitrogen applied. (For nitrogen produced by various types of livestock, see table 3). The Code further states that manure should not go on cropland after harvest if this land will be bare over the winter. To assist farmers in following this guideline, the UK Government has a grant program that covers half the cost of constructing the needed manure storage facilities (*3*). Such facilities will allow safe storage of manure through the fall and winter.

The Code also encourages the growing of cover crops in fields which would otherwise be bare during autumn and winter. The Code also states that there should not be autumn applications of manufactured nitrogen fertilizer, even to autumn-planted cereals.

In selected watersheds where water supplies have too high nitrate concentrations, 5-year demonstration projects for the control of manure and fertilizer use have recently been established. In these "nitrate sensitive areas," participating farmers will be compensated for income losses from adopting practices that go beyond good agricultural practices in the Code. Additional payments are made if farmers convert cropland to unfertilized, ungrazed grass, or to trees. When there is intensive livestock production in these areas, farmers are compensated for manure storage and manure transport, if needed.

So far, 60 percent of the farmers in these areas have agreed to participate. If not enough farmers volunteer to participate so that nitrate pollution is reduced, legislation allows public authorities to force compliance (*7*).

Denmark. Since the 1960's, the number of cows in the country has dropped by 40 percent while the number of pigs increased by almost 50 percent, changing cropping patterns and agriculture's impact on the environment (*13*). Temporary grass and fodder area was cut almost in half as cropland shifted to annual crops. Until 1989, 60 percent of these annual crops were planted in the spring and about 20 percent were winter crops planted in the autumn. Thus, most cropland was not covered by fall vegetation, raising the risk of nitrogen leaching.

Farmers and legislators believe that the manufactured fertilizers used to grow these annual crops are not a significant source of nitrogen pollution. Nitrogen pollution in Denmark is primarily due to inadequate handling of manure (*13*). Danish law requires farmers to prepare fertilization plans accounting for the application of both manure and manufactured fertilizers to be sure they will not cause pollution (*11*). To assist farmers in following the law, national farm organizations have selected 700

soil sampling sites to monitor soil nitrate levels and nitrate leaching. This sampling measures nitrate leaching from different soils under different management practices, information that helps farmers prepare their plans and is useful in the country's longrun assessment of the effectiveness of animal waste management.

Danish law also requires that 65 percent of the cropland of each farm must have fall vegetation to reduce the risk of nitrate leaching. Public authorities verify that farmers are meeting this crop cover requirement, and that they have appropriate crop fertilization plans.

Danish legislation also governs manure disposal (*13*). First, the law establishes maximum livestock concentrations per ha of land for manure disposal. If a farm exceeds this limit, the surplus manure is to be applied on neighboring farms. However, because manure cannot be applied with the same precision as manufactured fertilizer, there are problems in finding other farms to take surplus manure.

The law also requires that manure spread on bare fields must be plowed into the soil within 12 hours of application. Further, manure may not be spread on frozen or snow-covered land. This winter prohibition means that farmers must be able to store manure through the winter months. To this end, Danish legislation requires on-farm manure storage capacity equal to 9 months of manure production. To assist its farmers, the Danish Government covers up to 40 percent of the cost of constructing storage facilities (*5*).

Netherlands. Since 1971, it has been illegal to dispose of manure directly into surface waters (*19*). In 1984, to stop further increases of manure surpluses, pig and poultry farmers were no longer allowed to increase the size of their operations. Current law is phasing in increasingly stricter limits on manure spread per ha, according to soil type and crop grown. This legislation will be fully implemented by 2000. In addition, legislation also specifies that manure cannot go on cropland from harvest until November 1 and on grassland from October 1 to December 1.

Because the intensity of livestock production is so great in the Netherlands (table 1), the Dutch have a unique program of transporting surplus manure to manure-deficit regions of the country. The goal of this program is to allow Dutch farmers to continue their high-density livestock production. However, manure will not be transported great distances by the private sector because the nutrient content of manure is very low compared with manufactured fertilizers.

To overcome this problem, the Netherlands has a transport subsidy for shipments above 100 km for poultry manure and 50 km for any other type (*17*). For the transporter to be eligible for the subsidy, the livestock farmer must have paid a levy of $.53 per cubic meter ($m^3$) of poultry slurry manure and $.90 for other manure. There is an increasing schedule of subsidy by hauling distance. The poultry manure subsidy is $1.20 per m^3 up to 150 km, then it is raised to $2.20. Because other manures have lower nutrient concentrations, their subsidy is higher; $1.05 per m^3 for distances up to 100 km, $2.70 up to 150 km, and $3.70 above 150 km.

In addition to manure transport in the country, the Netherlands is experimenting with exporting it (after water removal and pelleting of the remaining solids). (The Dutch fertilizer industry already exports manufactured nitrogen fertilizer.) A state-subsidized pilot plant for manure processing is never expected to make a profit. The goal, as with the program to subsidize manure transport, is to ensure the survival of Dutch livestock farmers in those regions with the highest densities of livestock production.

The Dutch are also looking at other ways to handle their surplus manure. For example, there are experiments treating cattle manure with nitrous acid to neutralize ammonia and reduce acid rain problems (*18*). Since 1988, the Netherlands has been taxing livestock feed manufacturers to finance this and other research, as well as advisory services to farmers (*11*).

In addition to these general activities, the Dutch Government now has a program to strictly control land use near wellheads, almost 5 percent of the country's land area. The Government wants the municipal water authorities to purchase land nearest the wellhead and take it out of agricultural use. Water authorities have been able to purchase this land because provincial restrictions on the farmers to limit pollution are very severe. On land farther away, the water companies must compensate farmers for losses if farming practices are more limited than elsewhere. If livestock production is so great that there is surplus manure in the area, the water companies will pay farmers to transport it out of the wellhead area. If a provincial levy on water consumption has not been imposed to cover these costs, the water companies can raise consumer water rates. This wellhead protection program is to be reviewed in 1994. If it has not been effective, farmers in the wellhead area will be required to reduce livestock numbers (*7*).

Conclusion

The economics of modern confinement technology are shifting livestock production into highly specialized operations increasingly separate from crop production. When such operations become geographically concentrated, there can be adverse environmental consequences, including unacceptably high concentrations of nitrogen in public water supplies. This environmental consequence has put European livestock production at a crossroads.

The situation varies but is at its extreme in the Netherlands, where some areas have surplus manure (that is, no more manure can be safely put on the land no matter what adjustments are made to agricultural practices and the manure must be transported elsewhere or livestock density must be reduced).

Those countries or areas having high-nitrate water but not surplus manure have more options. If agricultural practices are sufficiently changed, public water supplies can be protected. Here countries are experimenting with various strategies.

The main issue is, who should bear the cost, beginning with the question of whether and to what extent the water should be allowed to become polluted. It might be cheaper for society to treat the high-nitrate water than to greatly change farming practices in an effort to reduce pollution.

If farming practices are to be changed, it must be decided if farmer participation is to be voluntary or compulsory. Incentives can encourage voluntary participation. The voluntary demonstration projects in the UK face a key question: will their cost be too high to extend to large areas of the country?

If the programs require farmer participation, compensation becomes an issue. Regulation without compensation, that is, the "polluter pays" principle, will make production uneconomical relative to production in unregulated areas or countries. This policy is, in effect, one of relocating livestock production.

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Australia's Environmental Degradation from Agriculture: Lingering Effects and Greater Visibility

by
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Abstract: *Past agricultural practices encouraged by government settlement and agricultural policies have altered the environment and will have a continuing effect on the condition of Australia's resources. The condition of Australia's land and water will in turn affect future productivity. Better knowledge of agriculture's effects on the environment and growing demand for environmental quality due to increased affluence can be expected to influence Government policies in the future.*

Keywords: *Agricultural policy, agricultural production, environmental quality, soil erosion, salinity, input subsidies.*

Agriculture has been a prominent sector of Australia's economy since the first European settlers arrived. Suitable agricultural systems were required for survival and then became a critical element in the successful colonization of the Australian continent. After World War II, manufacturing and service sectors increased, and agricultural production practices intensified as export markets expanded.

However, little attention was paid to the environmental consequences of the farm practices employed until Australia's population expanded, the importance of other economic sectors increased, and the effects on soil and water resources became more widely known.

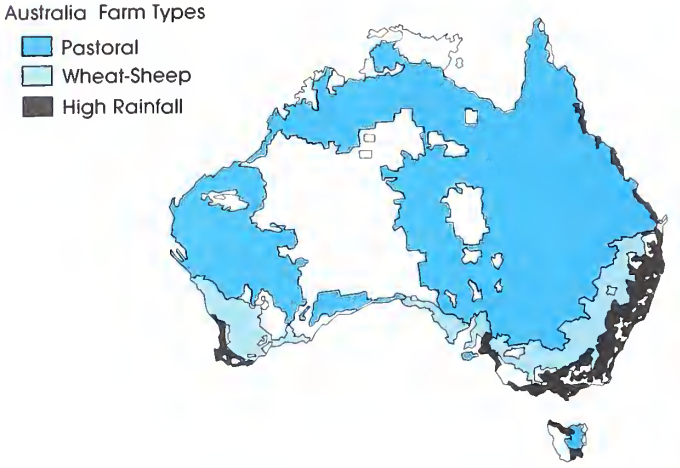
Agriculture and Environmental Change in Australia

In 1788 the first fleet landed, and Australia was established as a British convict settlement. During the first several decades of the settlement, difficulties in establishing agriculture meant that Australian farms were only able to supplement the supplies provided by Britain. As colonization progressed, agricultural systems developed that permitted Australia to become an exporter, first of wool, then of wheat, and eventually of other cereals, sugar, beef, cotton, fruits, and wine.

Australia's climate has strongly influenced the interaction between agriculture and environmental damage. Australia is the second driest continent, only Antartica is drier. The dry climate has caused hardships and economic disruptions leading numerous chroniclers to characterize Australia as a harsh, dry, and rugged continent. The dry climate is an integral component in the set of conditions that make Australia a fragile continent. The lack of precipitation means that underground salts have not been leached away as normally would occur in a climate with a higher rainfall. In addition, the dry climate means that water is less available to break down the bedrock so soils form more slowly. Thus, Australia has generally shallow soils and delicately balanced hydrologic conditions.

Australian agriculture has three broad zones: pastoral, wheat-sheep, and high rainfall (map 1). The pastoral zone covers the low-rainfall area in northern and central Australia. Agricultural production consists of extensive sheep, cattle, or sheep-cattle farms. The wheat-sheep zone includes the moderate rainfall, inland areas of eastern, southeastern, and southwestern Australia. The wheat-sheep zone is where farm production can shift quickly from wheat and other grains to sheep in response to market prices. Some portions of this zone that lie close to water sources produce high-value irrigated commodities such as fruit, cotton, and rice. Mountains separate the wheat-sheep zone from the high-rainfall zone, where production is more varied, including dairy, sheep, vegetables, sugarcane, and fruit.

Pastoral Area Is Australia's Dominant Agricultural Zone



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As Australian agriculture developed, increasing amounts of native vegetation were replaced by crops and pasture. This change of vegetation disturbed the natural hydrologic equilibrium associated with the native plant species and increased the rate of soil erosion (see box). In addition, farming practices associated with more intensive agriculture, such as irrigation and fertilization, led to difficulties with salinity, waterlogging, and soil acidity. In some cases, the environmental damage from agriculture was sufficient to cause the abandonment of farming.

Australian Agricultural Programs and Land Degradation

Government policies, such as subsidies or restrictions on management practices, can change the crops and livestock farmers produce and the way they produce them. Thus, changes in government policies can have a significant impact on the environment.

Australian policies affecting agricultural commodity markets tend to be less direct than those of the United States. For instance, rather than using support prices, export subsidies, and import barriers to stabilize farm incomes, Australia uses state and national marketing boards for grains, wool, and livestock. Intervention has also focused on land use, land tenure systems, irrigation programs, and input subsidies. Although these latter policies do not directly affect agricultural commodity markets, they do change economic incentives, and exert a substantial impact on agriculture and the environment.

The policies governing land settlement in Australia were designed to encourage economic and agricultural development. There were numerous variations on the theme, but most settlement policies required the clearing of a prescribed portion of land within a stated period of time to demonstrate the farmer's stewardship (*1, 2, 3*). Landowners often cleared land more rapidly than they could establish crops or improve pasture, leading to poor management practices (*3*). Frequently, shallow-rooted vegetation was substituted for the native deep-rooted species and the replacement of permanent ground cover with agricultural systems that periodically exposed the soil to erosive forces. In some instances, the introduced plant species could not survive the periodic drought conditions that are characteristic of western Victoria, New South Wales, and Queensland.

Another example of government land settlement programs were those that established farms of "an area sufficient to sustain a family in average seasons and conditions" (*5*). Unfortunately, in many cases the farms were not large enough to be operated efficiently and failed. The environmental degradation on these farms tends to be greater than on larger farms in the same area, probably because of overstocking the land in an effort to keep the farm solvent (*13*).

Over the years, Australia has subsidized irrigation water, and nitrogen and phosphate fertilizers to stimulate agricultural production. The subsidies lower the cost of these inputs relative to land rental, labor, and other inputs, increasing their use. Shifting relative costs can change the optimal rotation and production practices, which in turn can change physical and biological processes affecting hydrologic conditions, chemical reactions, and soil movement.

Australia subsidized nitrogen and phosphate fertilizers between 1966 and 1984, underwriting from 3.4 percent (1980-82) to 46.8 percent (1968-69) of the farmer's cost of nitrogen, and between nothing (1974-75) and 80.5 percent (1969-70) of the farmer's cost of phosphate (*10*). These subsidies increased fertilizer applications above what farmers would have used if they had had to pay the full market cost. During 1969-73, the subsidy may have increased phosphate use as much as 35 percent (*6*). Given the increase in soil acidity associated with the use of nitrogen and phosphate fertilizers and the increased use of fertilizers due to the subsidies, the subsidization of fertilizers may have contributed to the soil acidification observed in the 1980's.

While the subsidies for fertilizers have ended, those for irrigation continue. Irrigation projects constructed with federal funds provide water at rates that frequently do not cover the variable costs of delivery (*11*). In Victoria and New South Wales, a farmer with water entitlement can have a certain amount for a flat annual fee, whether the water is used or not. Because the farmer must pay a lump sum for the initial water allotments, the marginal cost of water approaches zero for those who use only their basic water allotment (*3*). This results in inefficient water use when the allocation provides more water than would be used under a unit pricing schedule. In periods of surplus flow, above-allocation water may be available to irrigators. This water is not free, but the price is usually subsidized.

The rules governing irrigation often act along with the pricing system to promote economic inefficiency. Irrigation permits are granted by the state on an annual basis, and technically renewals are not automatic. Water entitlements can be revoked for a number of reasons, the most significant being failure to establish a beneficial use for the water (*9*). This, coupled with the water rate structure, serves to encourage the full use of a farm's irrigation allotment.

Until recently, the irrigation rights were fixed and nontransferable, which led to economically inefficient use of the water. Producers with irrigation entitlements who faced low marginal returns from irrigation were encouraged to irrigate because they were prevented from transferring water to producers who are able to make better use of it. The regulations that have prevented the transfer of irrigation water are slowly changing, but curtail the movement of water beyond catchment boundaries.

This prevents the purchase of irrigation water by municipalities, the users with the greatest water demand.

The combined effect of these incentives to use water increased the water table in some irrigation districts and areas, resulting in waterlogging of some soils. It has also increased salinity in the irrigation tail water and reduced the water quality for irrigators and other users downstream.

The Future

Many factors will influence the relationship between agriculture and the environment over the foreseeable future. Three of the most important are: technological change, the effect of past agricultural practices, and increasing demand for environmental quality.

Technological change will most likely enable farmers to adopt more environmentally sound practices while increasing their net revenues. Recent examples are the introduction of minimum tillage in grain production and water conserving irrigation methods.

Australia has eliminated most of the agricultural programs affecting crop and sheep production, and with them a number of the unintended incentives to degrade the land. However, programs which have been terminated will continue to affect agriculture through their effects on the resource base. The changes in land and water quality have altered agricultural productivity and production practices.

Demand for environmentally sound agricultural production practices can be expected to follow the increasing trend displayed over the last several decades. Agriculture may be constrained through regulation, taxation, community pressure, or redefinition of property rights. This is particularly likely for practices such as irrigation and land clearing, which have an impact on neighboring communities.

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Land Degradation in Australia

Waterlogging. Australia's changing vegetation has led to rising water tables because shallow-rooted agricultural species were substituted for deep-rooted native vegetation. As the root zone was raised, the soil area affected by plant evapo-transpiration is reduced and the water table rises to fill the evacuated root zone as water is no longer removed by the plant cover. If the hydrologic system is disrupted beyond a certain point, the water table can rise to the soil surface, drowning crops and pasture. This is called waterlogging.

Dryland Salinity. A more prevalent problem is dryland salinity. This occurs when subsurface salt deposits combine with rising ground water tables. As the water table rises, salt is transported upward through the soil from the underground deposits. If the water table comes within 2 meters of the ground surface, salt concentrates in the root zone and crop and pasture productivity declines precipitously (*8*). An indication of the extent of the problem can be obtained by examining dryland salinity in the Western Australian wheat-sheep zone, which largely came into production during the 20th century. Since 1955 when the first survey was conducted, the area of dryland salinity has increased 500 percent (*4*).

Soil Erosion. Soil erosion, which occurs naturally, accelerates when the soil cover decreases or the soil is disturbed. The soil cultivation associated with crop production and the changes in vegetative cover associated with expanded agricultural production have increased soil erosion. In addition, the fallowing of paddocks associated with crop production in dry climates has further accelerated soil erosion. The increased soil erosion is of concern because with shallow soils and a slow rate of soil formation, a small amount of soil loss can be reflected in decreased crop yields and reduced stocking capacities. In 1984, it was estimated that about 38 percent of the nonarid areas in Australia had soil erosion problems requiring treatment (*12*).

Irrigation Salinity and **Soil Acidity.** In addition to the forms of environmental degradation that occur when the native vegetation is altered, there are those that occur due to the application of inputs on agricultural areas. In Australia, the two inputs which have caused the greatest problems are irrigation water and nitrogen and superphosphate fertilizers. Irrigation increases ground water levels and leads to waterlogging and salinity problems similar to those associated with dryland salinity. The waterlogging and salinity caused by irrigation lead to the same declines in production as dryland salinity. Application of nitrogen and superphosphate fertilizers has led to soil acidification. Soil acidity reduces availability of nutrients to plants, causing a reduction in crop and pasture productivity.

Government Intervention in South Korean Agriculture

by
J. Albert Evans*

Abstract: *South Korea's aggregate assistance to agriculture, weighted heavily by rice, was highest after Japan among developed countries, with 89 percent of support stemming from price intervention measures. South Korean Government assistance in 1987-89 was generally higher for crops than for livestock products. Among the latter, beef and milk were more heavily assisted than chickens, eggs, and pork.*

Keywords: *South Korea, producer subsidy equivalent, consumer subsidy equivalent, price intervention assistance, budgetary program assistance.*

The South Korean Government provides very high levels of assistance to agricultural producers while heavily taxing consumers. Assistance to producers in 1987-89 was about double the level in the United States, 1.6 times that in the European Community, and nearly 80 percent that in Japan, the most heavily assisted developed country. These ratios are derived from producer and consumer subsidy equivalents (PSE's and CSE's) for nine commodities. (See Box)

South Korea has been transformed since the early 1960's from a poor agrarian economy to a highly industrialized upper-middle-income economy. The adoption of a "high price policy" for rice and barley producers in 1968 started South Korea toward the objective of agricultural self-sufficiency or food security for major crop and livestock products, and a related goal of greater parity between rural and urban incomes. Food security is important to South Koreans because they remember the deleterious effects of major shortages of basic staples under Japanese colonial rule and later during the Korean War.

South Korea's food security and rural development policies are widely perceived as underpinning public welfare, and economic and political stability. South Korea's Economic Planning Board (EPB), a powerful agency, recognizes the need for restructuring agriculture to seek international competitiveness, but the process is being slowed by the political reality that a high percentage of South Koreans still have relatives on farms or in rural areas and do not want to see them hurt by farm sector adjustments meant to further trade liberalization objectives.

South Korea's import barriers on many products cause conflicts with agricultural exporting countries, such as the United States, that seek to expand trade and reduce overall trade deficits with South Korea. Paradoxically, South Korea's export-led economy depends on access to foreign markets for commodities such as automobiles, textiles, leather goods, and footwear. These divergent domestic interests concerning trade liberalization have created a dilemma for South Korean policymakers.

Although food grains continue to dominate farm income, the shares from fruits, vegetables, and livestock products have risen rapidly as these products increasingly supplement cereals in the Korean diet. Economic and population growth are raising demands for agricultural products and imports. Because of South Korea's interventionist policies, its highly assisted grain, soybean, beef, and milk producers remain quite inefficient by international standards.

Kinds of Assistance

Price Intervention—Major intervention policies that distort prices include state trading, import quotas and tariffs, producer price supports, and retail price ceilings for various commodities (*1, 30*). These policies permit agricultural producers to obtain commodity prices that exceed prevailing world market levels, with the difference paid by consumers through higher prices (*20*).

The combined effects of all price intervention policies for any given commodity are estimated by a single price gap because of the problem of sorting out their separate effects. Such policies accounted for 89 percent of total South Korean Government assistance to producers of the selected commodities in 1987-89.

Parastatal Organizations—South Korea's Ministry of Agriculture, Forestry and Fisheries (MAFF) has overall authority for food grain and other price support programs, land and water resource development, fertilizer distribution, credit and marketing programs, and import and export policies. Organizations of a semi-public character, known as parastatals, also are active in assisting South Korean agriculture through price controls or product marketing. These include the National Agricultural Cooperatives Federation (NACF), the Agricultural and Fisheries Marketing Corporation (AFMC), the National Livestock Cooperatives Federation (NLCF), and the Livestock Products Marketing Organization (LPMO).

The NACF administers grain and soybean price support and distribution programs, and is responsible for distributing production inputs, including fertilizer, pesticides, and farm machinery. It supplies farm credit, processes and markets farm products, conducts research, sells various

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subsidized agricultural inputs, and provides management guidance to farmers.

The AFMC (formerly the Agricultural and Fisheries Development Corporation) has sole authority to import food-use soybeans. Each of the three soybean crushing companies is authorized to import for crushing, up to allocated levels established by the MAFF based on its determination of an annual import quota.

The NLCF controls the Livestock Development Fund (LDF) and is authorized to make development and production loans to cooperative members. The LPMO marks up resale prices of imported beef to hotels and for general consumption, depositing the net proceeds beyond handling costs into the LDF.

Expenditures from the LDF, approved by the MAFF, support activities such as livestock research, and infrastructure improvement loans to farmers. Other functions of the NLCF include extension work and agribusiness development. The NLCF imports and exports livestock products (except beef), as determined by the MAFF.

The South Korean Government set the LPMO up in late 1988 as the sole state trading organization for importing beef. According to its bylaws, the purpose of the LPMO is to increase livestock farmer incomes and stabilize livestock product prices through smooth adjustments in supply and distribution (*12, 17*).

Individual Product Laws—Individual product laws, an issue in recent U.S.-South Korean trade talks, underpin domestic subsidies and import protection. These laws are often vaguely worded but are the basis for regulations or guidelines which frequently are not publicized and allow wide administrative discretion. Commodity-specific individual laws include, among others, the Food Grain and Feed Management Acts of 1950, the Livestock Law, and the Animal Quarantine Act.

The grain management laws of 1950 are still the basic legal authority that is central to government farm policy. Under these laws, the Government is the ultimate authority to approve or deny import licensing.

Budgetary Programs—Aggregate outlays for 10 budgeted programs of assistance to agriculture increased 37 percent between 1987 and 1989, continuing the strong uptrend of recent decades. Budget allocations for development programs designated as "Agricultural Development," "Irrigation Development," and "Agricultural Infrastructure Development" amounted to 76 percent of the 1989 total budget of 1.12 trillion won ($1.67 billion) and reflected the greatest areas of growth in 1987-89 (table 1). (In tables 2 and 3 showing calculations of PSE's and CSE's, government budget assistance under these 10 programs is aggregated into four generalized categories (inputs assistance, marketing assistance, infrastructure support, and regional support) under the heading "Policy Transfers.")

Mechanization, through credit supplied by the NACF, is still strongly encouraged, primarily because it enhances the productivity of labor for rice and allows time to establish a supplementary crop of winter barley or greenhouse vegetables. The Government has maintained a dominant role in large and medium-scale projects that include forest land reclamation, tidal land development, irrigation and drainage facilities, and farmland rearrangement of small fragmented fields after the land is leveled.

Under the Saemael (New Community) initiative, investment projects continue to be undertaken to improve rural living conditions by providing sanitary water supply systems, better sewage systems, housing, and village reconstruction. Other projects include paving roads and rural electrification. To enable the marketing network to handle the increased volume and variety of agricultural products, the Government is modernizing markets while seeking increased private ownership of wholesale outlets.

In 1987-89, producers of chickens, eggs, and hogs received a higher proportion of total government assistance from budgetary programs than did producers of other commodities. Budgetary assistance was relatively more important to livestock producers than to crop producers, although rice growers received the greatest absolute benefit from such programs.

Budgetary programs in 1987-89 accounted for only 11 percent of total government aid to South Korean agriculture. In contrast to price intervention, budget outlays are taxpayer transfers to agricultural producers and usually do not otherwise entail costs to consumers.

Assistance to Crop Producers

Food Grains—Rice's 39-percent share of farm output and status as the major food grain make it the keystone of South Korean agricultural policy and give it great weight in the average level of assistance to agriculture. Under the dual price system for rice and barley, support prices are paid to producers. Consumers pay prices below the NACF's cost of acquisition and handling but still above world price levels. This arrangement is reflected by increasing deficits in the Grain Management Fund, which finances NACF purchases of significant shares of the total outputs of rice, barley, and more recently, soybeans. Government support for rice includes a ban on imports.

Rice producers received 90 percent of their assistance in 1987-89 from price intervention policies (table 4). Government budget outlays constituted the remainder, with infrastructure support and marketing assistance most important.

Food grain consumers in 1987-89 were taxed heavily but at lower levels than producers were assisted. Subsidized

rice was provided to institutions, including public hospitals, police forces, and the military.

The high level of government assistance to barley producers (89 percent) reflects the continuing incorrect perception of barley as a major food grain rather than an important secondary and complementary crop to rice. Domestic barley is now used primarily in livestock feeds and in producing malted beverages, including beer. Food use of barley was less than 2 percent of total food grain use in 1987-89. Subsidies to producers included price supports and collection losses on credit extended for purchases of fertilizer, seeds, and other chemicals.

Corn—Corn is the major South Korean feed grain. Imports accounted for 98 percent of corn use in 1987-89. In 1987-89, South Korean corn producers received total government assistance equivalent to 76 percent of the value of corn output (table 4). Budgetary assistance was mainly due to subsidized fertilizer prices.

The NACF, as the government buying agent, purchases all corn offered by farmers, selling the great bulk of it to feed mills and the rest to companies of the Korea Corn Processors Association. Feed manufacturers are forced to buy domestic corn from the NACF at its cost of acquisition and handling, which continues to be several times greater than the import price. Since 1984, individual feed mills and the NLCF—as well as the Korea Feed Association, formerly the sole importer—have been authorized to import feed corn.

Soybeans—Almost all of the domestic soybean output is for human use. About 80 percent of soybeans consumed are imported under quotas, subject to a 3-percent tariff that began in 1988. Assistance to South Korean soybean producers in 1987-89, indicated by a PSE of 86 percent (table 4), was essentially the same as levels for rice and barley. Budgetary subsidies provided about 10 percent of total assistance, primarily for inputs such as seed and fertilizer, for marketing assistance, and regional and infrastructure support. The MAFF emphasizes soybean production through high price supports, budgetary assistance, and border policies (*27*).

Consumer taxes on soybeans were relatively high in 1987-89 at 79 percent of total consumer cost, about the same as on rice and barley. The cost of domestic soybean price support programs and the effects of import quotas and restrictions are passed on to consumers, which keeps prices for soybeans very high.

Refined Sugar—South Korea does not produce raw sugar, and relies entirely on imports for its processing industry. Domestically refined sugar satisfies internal needs and enters export channels around the world. Domestic consumers of refined sugar were taxed in 1987-89 to the extent of 54 percent of their total product cost, benefiting domestic processors and companies that trade sugar products in South Korea and in export markets.

Assistance to Livestock Producers

As measured by PSE's, government assistance to producers of meats, milk, and eggs in 1987-89 was well below levels for rice, barley, corn, and soybeans (table 4). The lower rates to livestock producers is partly explained by the dominant food security focus on food grains. In addition, there are far fewer livestock producers than grain producers, and consequently they have less political clout.

Producer assistance for beef (67 percent) and milk (64 percent) was about three-fourths the rates for rice and barley, and about double those for chicken and eggs. Assistance to producers of pork, an export commodity, was lowest. Overall, government assistance to livestock producers averaged 45 percent in 1987-89, somewhat more than consumers were taxed (38 percent).

Despite high prices, South Koreans have increased their dietary intake of meats (*20*). Per capita meat consumption, 17 kilograms per year in 1987-89, was 72 percent more than in 1977-79. Pork's 59-percent share of total meat use in 1987-89 was about triple that of beef (the preferred meat) and chicken. Per capita pork consumption doubled during the decade, far exceeding growth for chicken (52 percent), and beef (25 percent). Milk use per capita more than tripled and eggs gained 58 percent.

Beef—Of 1987-89 government assistance to beef, 91 percent reflects various price intervention policies (table 4). These include a 20-percent tariff, beef import quotas that have been increased since mid-1989 following a 4-year virtual ban, State trading through the NLCF and later the LPMO, and parastatal control of beef marketing and distribution. A cattle price stabilization program was implemented in July 1988, also administered by the LPMO (*29*).

Currently, all imported beef carcasses (sold at a sharp discount compared to domestic carcasses) are deboned at Korea Cold Storage Company (KCS) facilities and then marketed at the rapidly expanding number of stores established by the KCS or the NLCF exclusively to sell imported beef. Boned high-quality beef (HQB) is distributed through the Korea Tourist Hotel Supply Center (KTHSC) to hotels; is auctioned to wholesalers, purveyors, or restaurants; or is sold directly to private retailers (*26*).

The South Korean Government will allow retailers of beef (and pork) in late 1991 to set prices on products by grade and cut. South Korea presently has no grading system for beef, either carcass or cut. The United States competes strongly in the HQB sector of South Korea's market, which previously was limited almost exclusively to hotels and upscale restaurants.

Beef imports by South Korea are scheduled to increase under an April 1990 Beef Memorandum of Understanding with the United States, which set a minimum import quota of 58,000 tons (customs clearance basis) in 1990 and 66,000 in 1992. In addition, a Simultaneous Buy/Sell

system somewhat similar to one in Japan has been established, whereby South Korean beef buyers, such as hotels, can negotiate product specifications and prices directly with sellers. The LPMO will remain the monopoly importer of beef (*26*).

South Korea actually imported more than 100,000 tons of beef in 1990, 30 percent from the United States. But the import market is obviously much larger than this. A recent study projects South Korean imports of beef in the year 2000, assuming no constraints, to be between 340,000 and 700,000 tons (*7*).

Minimum beef import increases for 1993 through 1997 are subject to future negotiations. In October 1987, South Korea agreed to disinvoke use of GATT article XVIII(B) to justify import restrictions on balance of payments grounds. South Korea has until July 1, 1997, to fulfill a commitment to remove all import restrictions or to bring its policies into conformity with the GATT.

Pork—Pork production and consumption grew more than beef mainly because of lower prices. Government assistance to pork producers (20 percent in 1987-89) is still primarily provided by border measures that limit imports, subject to a 25-percent tariff. Imports of canned pork were liberalized on July 1, 1987.

Government assistance to pork producers was significantly less in 1987-89 than earlier in the 1980's, although this decline may reflect problems with the reference prices used to calculate the PSE's rather than a fundamental policy change. A sharp 70-percent growth in the South Korean swine inventory during 1986-89 resulted in substantially lower prices for hogs, and for pork carcasses on which the PSE calculations are based. Thus, lower average prices for domestic pork carcasses in 1987-89, combined with only small increases in the reference price (Taiwanese pork carcasses), greatly narrowed the price gap used in determining PSE's.

Occasionally, the NLCF purchases hogs or pork to aid in stabilizing prices and supplies. More often it attempts to reduce the instability in hog production by pressuring large producers to expand or decrease their herds. Exports of pork averaged only 8,000 tons in 1987-89, nearly all to Japan. The Government limits the size of individual hog operations to no more than 1,000 sows or 10,000 total hogs.

The NLCF allows subsidized imports of swine (cattle and poultry also) for breeding purposes, subject to a tariff. Other benefits provided livestock producers include loans for livestock purchases and subsidies for pasture and other forage production. The NLCF also operates rural livestock markets. It collects pigs produced by large growers through purchase or consignment, and arranges transportation to NLCF slaughterhouses in urban areas.

Chicken—Chicken accounts for 98 percent of total poultry meat production and consumption in South Korea. The broiler industry will continue to grow with increasing consumer income, an expanding fast-food industry, and population growth.

Assistance for chicken producers (34 percent in 1987-89) is mainly accomplished through border restrictions, but sometimes the MAFF stabilizes producer prices through market purchases of chicken. Imports of fresh, chilled, and frozen chicken are highly restricted and subject to a 20-percent tariff. Canned poultry meat and turkey imports were liberalized July 1, 1987 (*28*).

The South Korean Government is subsidizing eight broiler companies to aid in integrating their operations. The industry, mainly controlled by large operators, realizes the need for increased efficiency to become internationally competitive within the next decade.

Eggs—Government assistance for egg producers (26 percent in 1987-89) is accomplished mainly through border restrictions that limit imports. Imports of eggs and egg products had been banned under the Government's Import Surveillance System until it was abolished January 1, 1989. Subsequently, shell eggs and dried egg yolks may be imported, subject to a 30-percent tariff, which is likely to continue for at least another 3 years. However, domestic production of fresh eggs currently is sufficient to satisfy demand. The South Korean chicken industry may soon become competitive enough to export chicks for breeding.

Milk—Nearly 90 percent of South Korea's milk output is consumed fresh. The comparatively high level of assistance to milk producers in 1987-89 (64 percent) stems from government established prices for raw milk and from highly restrictive border policies that ban most dairy product imports by the NLCF, the only legal importer (*18, 24*). Dairy processing companies purchase raw milk directly from producers at prices set by the Government after negotiations that include producers, processors, and the MAFF.

South Korea's dairy industry is a recent development, beginning with the purchase of 2,000 Holsteins from the United States and Canada in 1962. The dairy herd size now exceeds 500,000 animals, all Holsteins. The Government, through the MAFF and parastatal organizations, has directed the development of the industry from its inception. Growth of the industry is likely to slow in the 1990's compared with the 1980's because the shortfall in domestic milk output has been greatly reduced, even as consumer awareness of milk has reached a high level.

Growth in milk consumption has averaged about 19 percent annually for more than a decade. Before the mid-1970's, use of milk and dairy products was very low because of limited production, lower per capita incomes,

Calculating South Korea's PSE's and CSE's

Producer subsidy equivalents (PSE's) and consumer subsidy equivalents (CSE's) are a commodity-specific, short-hand way of describing the effect of government intervention on producers and consumers.

A PSE is defined as that subsidy level required to remunerate producers of a commodity for withdrawing government support. The percentage PSE is the ratio of the total value of policy transfers to the total value of agricultural production. A positive PSE denotes producer assistance, and a negative PSE producer taxation. Likewise, a CSE is defined as the subsidy level that would be required to compensate consumers for the removal of beneficial agricul-

Table 1—Budget of South Korea's Ministry of Agriculture, Forestry, and Fisheries

Selected program	1987	1988	1989
	100 million won		
Food production	80	79	96
Agricultural mechanization	81	684	726
Irrigation development	1,540	2,160	2,018
Agricultural infrastructure development	1,156	1,578	1,900
Integrated large scale agricultural development	1,076	1,035	941
Marketing improvement	319	620	309
Specialized agricultural and livestock project	140	706	128
Agricultural development	1,815	2,775	3,903
Rural income source development	1,817	809	976
Current expenditure	125	234	207
Total, above programs	8,149	10,680	11,204
In million U.S. dollars 1/	991	1,461	1,670

1/ Converted at exchange rates of 823 won/dollar in 1987m 731 in 1988, and 671 in 1989.
Sources: (4, 8).

Table 2—Calculation of PSE's and CSE's for crops, 1987-89 average

Item	Unit	Rice	Corn	Barley	Wheat flour	Soybeans	Refined sugar
Producer subsidy equivalents:							
Production	1,000 tons	1/ 5,809	118	1/ 531	NE	231	NE
Producer price	won/kg	2/ 972	289	3/ 568	NE	955	NE
Producer value 4/	Bil. won	5,646	34	302	NE	221	NE
Policy transfers:							
Price intervention 5/	Bil. won	4,353	25	250	NE	175	NE
Marketing assistance 6/	Bil. won	112	-	6	NE	4	NE
Infrastructure support 7/	Bil. won	280	-	6	NE	4	NE
Regional support 8/	Bil. won	87	1	4	NE	3	NE
Inputs assistance 9/	Bil. won	28	-	4	NE	3	NE
Total policy transfers	Bil. won	4,860	26	270	NE	189	NE
Producer subsidy equivalent 10/	Percent	86	76	89	NE	86	NE
Producer subsidy equivalent 11/	$/ton	1,145	297	691	NE	1,127	NE
Consumer subsidy equivalents:							
Consumption	1,000 tons	5,652	NE	531	1,667	1,256	662
Consumer price (wholesale) 12/	won/kg	1,008	NE	466	226	967	474
Total consumer cost 13/	Bil. won	5,697	NE	247	377	1,215	314
Total policy transfers	Bil. won	-4,444	NE	-200	-54	-965	-169
Price intervention 14/	Bil. won	-4,444	NE	-200	-54	-965	-169
Consumer subsidy equivalent 15/	Percent	-78	NE	-81	-14	-79	-54
Consumer subsidy equivalent 16/	$/ton	-1,075	NE	-509	-16	-1,046	-341

Note: A negative number implies a tax. NE = Not estimated.
1/ Polished. 2/ Average price weighted by production for traditional (Japonica) and high yielding (Indica) types of rice. 3/ Average price weighted by production of common, naked, and malting (beer) types of barley. 4/ Equals production times producer price. 5/ Includes the effects of restrictive border measures and price stabilization (State control) programs. Price intervention is measured by the difference between domestic producer prices and actual import unit values (proxy import values for rice and barley because imports are banned) multiplied by domestic production. 6/ Government budget subsidy program designated as agricultural development in (8), 1989, pp. 72-73; comparable data from 1987 and 1988 issues. 7/Includes Government budget subsidies designated in (8) as (i) agricultural infrastructure development, (ii) irrigation development, and (iii) large-scale agricultural development. 8/ Government budget subsidy program designated as rural income source development. 9/ Government budget subsidies designated as (i) agricultural mechanization, and (ii) food production. 10/ Ratio of total policy transfers to producer value. 11/ Total 1987-89 policy transfers, converted into U.S. dollars, divided by 1987-89 production. 12/ Wholesale prices for milled average quality rice, barley, first grade wheat flour, average quality beans, and refined white sugar. 13/ Consumption times consumer price. 14/ The total effect of Government price intervention was estimated as the product of a derived price gap per unit of product consumed and total consumption. The price gaps per unit of consumption are the difference between the above consumer prices and actual import unit values, or proxy import unit values in the case of rice and barley, for which imports remain banned. Wheat flour imports are virtually nil. 15/ Ratio of total policy transfers to total consumer cost. 16/ Total policy transfers converted to U.S. dollars, divided by consumption, based on won exchange rates per dollar of 823 in 1987, 731 in 1988, and 671 in 1989.
Sources: (2, 3, 4, 5, 9, 13, 15, 16, 19, 22).

tural programs. The CSE, in percentage terms, reflects the ratio of the total value of policy transfers received by consumers for a product to total consumer cost. CSE's also may be positive (net assistance) or negative (net taxation).

PSE's were calculated for rice, barley, corn, soybeans, beef, pork, chicken, milk, and eggs. CSE's were calculated for the same commodities (except corn) plus wheat flour.

In calculating PSE's and CSE's for South Korea, a number of methodological conventions were made. Some of these are described in the footnotes to the tables reporting the results.

One important convention in this research is that state trading is defined as exclusive trading in an agricultural commodity by a government agency or government-sponsored agency and includes importing/exporting authority, and often involves product distribution activities.

Table 3—Calculation of PSE's and CSE's for livestock products, 1987-89 average

Item	Unit	Beef	Pork	Chicken	Eggs	Milk
Producer subsidy equivalents:						
Production 1/	1,000 tons	167	431	148	380	1,565
Producer price 2/	won/kg	5,023	1,795	1,623	845	333
Producer value 3/	Bil. won	871	774	240	321	521
Policy transfers:						
Price intervention 4/	Bil. won	512	81	60	61	295
Marketing assistance 5/	Bil. won	18	27	8	18	14
Infrastructure support 6/	Bil. won	21	33	10	10	16
Inputs assistance 7/	Bil. won	—	1	—	—	—
Regional support 8/	Bil. won	10	15	4	54	8
Total policy transfers	Bil. won	561	157	82	83	333
Producer subsidy equivalent 9/	Percent	67	20	34	26	64
Producer subsidy equivalent 10/	$/ton	4,636	480	753	314	292
Consumer subsidy equivalents:						
Consumption	1,000 tons	202	423	148	380	1,176
Consumer price 11/	won/kg	8,265	3,139	1,792	1,034	756
Total consumer cost 12/	Bil. won	1,670	1,328	265	393	889
Price intervention	Bil. won	13/ -1,128	14/ 206	15/ -85	16/ -133	17/ -725
Total policy transfers	Bil. won	-1,128	206	-85	-133	-725
Consumer subsidy equivalent 18/	Percent	-68	16	-32	-34	-82
Consumer subsidy equivalent 19/	$/ton	-7,692	653	-785	-489	-851

Note: A negative number implies a tax. — = Less than 500 million won. 1/ Wholesale carcass weights for meats. 2/ Wholesale carcass meat prices; wholesale price for large eggs; retail price for fluid-grade milk. 3/Equals production times producer or wholesale price. 4/ Price intervention is measured by the difference between the wholesale price (producer price for milk) and an import unit value or reference price for a selected neighboring country, multiplied by domestic production. For beef the reference (proxy) import unit value of bone-in-beef imported by South Korea from Australia was used and for pork, the wholesale average price of pork carcasses in Taiwan was used as a proxy, adjusted to include an estimate for shipping Taiwanese pork to South Korea. Poultry meat proxy unit value price was calculated from Japanese imports of chicken meat from the United States, and for eggs from Official imports of fresh eggs by Hong Kong. For milk price intervention was determined as the difference between the producer price and the import unit value for South Korean imports of milk powder (converted to whole milk equivalent), multiplied by domestic production of milk. 5/ Government budget subsidy programs designated as "Agricultural Development", and "Specialized Agricultural and Livestock Project" from (8). 6/ Government budget subsidies designated as "Agricultural Infrastructure Development" and "Large-scale Agricultural Development". 7/ Government budget subsidies included under program titled "Food Production." 8/ Government budget subsidy program designated "Rural Income Source Development". 9/ Ratio of total policy transfers to appropriate producer or wholesale value. 10/ Total 1987-89 policy transfers, converted into U.S. dollars, divided by 1987-89 production. 11/ For beef the retail price of boneless beef in Seoul; for pork the average retail price of boneless pork in "all cities"; for poultry meat the "all-cities" average retail price for chicken meat since 1985 is adjusted annually by the change in the retail price of chicken meat in Seoul. The egg retail price is for large eggs. Retail price was used for milk. 12/ Consumption times consumer price. 13/ The difference (price gap) between the consumer price and the import unit value of boneless beef imported by Hong Kong from Australia times consumption. 14/ The gap between the South Korean average retail price for boneless pork in "all cities" and the export unit value of Taiwanese pork in Japan used as a proxy reference price in light of the South Korean ban on pork imports. 15/ The gap between the consumer price and proxy import unit value for Japanese imports of chicken meat from the U.S., multiplied by consumption. 16/ The gap between consumer price and a proxy import unit value for fresh egg imports by Hong Kong, multiplied by consumption. 17/ The price gap between consumer price and the whole milk equivalent import unit value of South Korean imports of milk powder, times milk consumption. 18/ Ratio of total policy transfers to total consumer cost. 19/ Total 1987-89 policy transfers, converted into U.S. dollars, divided by 1987-89 consumption.

Sources: (3, 6, 9, 10, 11, 14, 16, 23, 25)

Aggregate assistance to producers or consumers from price intervention policies is derived as the gap between the domestic producer price or consumer cost for each product and the corresponding import unit values (or proxy import values if imports are banned, as is the case for rice and barley), multiplied by the production or consumption quantity of each product.

Recipients of government agricultural budget programs include nonfarm rural residents and part-time farmers whose earnings are primarily from non-farm sources. Hence, it is difficult to determine budgetary outlays for those involved only in agriculture, and to allocate program expenses among the various commodities without having more program details than ERS has been able to obtain from the MAFF.

Table 4—PSE's and CSE's for South Korean agricultural products, 1987-89 average

Commodity	Self-sufficiency ratio 1/	Share of agricultural output	PSE	CSE	PSE	CSE	PSE share accounted for by: Price intervention 2/	PSE share accounted for by: Budget outlays 3/
		Percent			*Dollars per ton*		*Percent*	
Grains:								
Rice	100	39	86	-78	1,145	-1,075	90	10
Wheat flour	0	0	NE	-5	NE	-16	NA	NA
Barley	100	2	89	-81	691	-509	93	7
Corn	2	0.2	76	NE	297	NE	96	4
Industrial crops:								
Soybeans	20	1	86	-79	1,127	-1,046	92	8
Refined sugar	0	NA	NA	-54	NA	-341	NA	NA
Livestock products:								
Milk	100	3	64	-82	292	-851	89	11
Beef	60	5	67	-68	4,636	-7,692	91	9
Pork	102	8	20	16	480	653	52	48
Chicken	100	2	34	-32	753	-785	73	27
Eggs	100	2	26	-34	314	-489	73	27
Group totals:								
Crops	NA	42	86	-75	NA	NA	90	10
Livestock products	NA	20	45	-41	NA	NA	82	18
All above commodities	NA	62	74	-62	NA	NA	89	11

Note: A negative number implies a tax. NA = Not applicable. NE = Not estimated.

1/ In 1989. 2/ Includes assistance from tariffs, price stabilization schemes linked to import controls, and state trading. 3/ Includes national government budgetary programs.

Sources: Tables 2 and 3, and (4, 9, 13, 16).

and lack of consumer awareness. The Government continues to support a subsidized nationwide program of supplying milk to schools. Still, consumers of milk in general were taxed (82 percent) relatively more than were consumers of other livestock products.

Conclusions

South Korean producers are greatly assisted by Government policies that support domestic commodity prices, supply subsidized inputs and credit, and ban or restrain imports. Pervasive government intervention in agriculture is consistent with the objectives of agricultural self-sufficiency, higher rural living standards, and agricultural development. South Korean policies that contribute most to agricultural price distortions include import bans, quotas and tariffs, state trading, producer price supports, and retail price stabilization programs. Consumers are taxed through higher prices to cover a high percentage of such assistance to producers. Budgetary program assistance, the costs of which are borne by taxpayers, was a small portion of total assistance for all commodities.

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